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EVIDENCE-BASED SPATIAL INTERVENTION FOR REGENERATION OF DETERIORATING URBAN AREAS, A CASE OF STUDY FROM TEHRAN, IRAN

by

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Declaration:

I declare that this thesis has been composed by the myself, the work is my own, and it has not been submitted for any other degree or professional qualification.

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17/19/2011

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Abstract

Throughout the urban development process over the last seven decades in Tehran, the capital city of Iran, many self-generated neighbourhoods have developed in which the majority of the residents are low-income families. On one hand, the main spatial attribute of these deprived neighbourhoods is spatial isolation from the surrounding, more affluent areas, which is accompanied by inadequate urban infrastructure and a lack of accessibility and permeability. On the other hand, the Tehran City Revitalisation Organisation - the governmental sector which is in charge of the deprived areas - is incapable of conducting urban regenerations without investment from the private sector, and is seeking methods to create 'socio-economic stimulant zones' to attract private sector participation in regeneration programmes.

In this regard, this research investigates the notion of 'spatial isolation' which in return causes socio-economic isolation as highlighted in the literature. The research suggests that in order to develop feasible regeneration programmes, which can meet the interest of both people and government, and release the deprived area from isolation both spatially and socio-economically, the regeneration plans should focus on public open space developments as 'socio-economic stimulant zones'. With regard to this idea, the research highlights the street as a 'social arena' – not arteries or thoroughfares – as the type of public open space in which its development could not only release the deprived areas from spatial isolation, but could also direct more pedestrian movement to and through the deprived neighbourhoods, making more opportunities for the creation of socio-economic interactions.

In this respect, the theory of 'natural movement' and theories and literature of 'integrated public open spaces' form the theoretical framework of the research to support this idea. For further investigation, two case studies, one as the deprived area and one as the control area, have been chosen, and the spatial pattern of the city and the two cases have been analysed in regard to the notion of 'spatial isolation' through Space Syntax using Depthmap software and GIS. Also, the correlation between the distribution pattern of commercial land uses and syntactic measures across the city of Tehran is investigated to identify the potential streets in which to create commercial opportunities. Afterwards, in order to study the street life and the variety of activities the streets can afford, a few locally integrated streets in the deprived case have been chosen. At this stage, nineteen behaviours have been observed and classified in five major classes including the necessary, social, optional, hazardous, and occasional activities, and the correlation with syntactic measures are studied. Moreover, the methods of developing a route filtering system and a transformability index for identifying the most suitable streets for the creation of a pedestrian friendly network are discussed, using an example of a deprived area, integrating it with the surrounding urban fabric to create the 'socio-economic stimulant zones'. The results show that by identifying the underlying spatial pattern of the urban fabric, it is possible to release the deprived areas from its spatial isolation through developing a street network without causing urban fragmentation. This approach could also form a cost-effective basis for developing a pedestrian friendly street network as one of the 'socio-economic stimulant zones', which the Tehran City Revitalisation Organisation is looking for; the type of streets that not only support the necessary activities and transportation, but could also facilitate socio-economic interaction.

Keywords: space syntax, route filtering system, transformability index, urban regeneration, street life, spatial structure, Tehran, Iran.

Table of Contents

1. Chapter One: Introduction

In this chapter, the outline of the thesis, the summary of the context, theoretical foundations and methodological framework of the research, the research goals, objectives, questions and assumptions are briefly discussed.

1.1. Summary of the research context

As a result of quick, car-orientated development in the cities of Iran, the urban planning regime is overwhelmed by the decisions made by traffic engineers in favour of developing more highways and widening the streets to provide enough space for cars. History of urban development shows that the Municipality of Tehran, the capital city of Iran [Figure 1-1], has also been supportive to this process (Andalib, 2007a, b, c, d). One reason for that could be the fact that physical development is more sensible for the public than social and economic developments and the authorities can 'show off' that the development has been completed over a certain period of time. On the other hand, the major obstacle for the Municipality of Tehran is dealing with the widespread deteriorating areas, which cover considerable areas of Tehran's territory. The Municipality of Tehran, which is in favour of developing thoroughfares and highways, tried to deal with the widespread deteriorating areas by directing the highways from the middle of these areas, in order to trigger private sector participation. In this regard, the Navvab Highway project [Figure 3-28] was developed and completed in 2003, and huge socio-economic and spatial failures were revealed immediately after the completion (Andalib, 2007a).

Figure 1-1: The location of Tehran and Iran in the Middle East region (Google Map 2011)

In order to avoid the repetition of Navvab Highway failure, the Municipality of Tehran developed a theoretical framework called the 'Revitalisation Special Plan' to monitor the intervention into the extensive deteriorating areas. However, this plan is not working as effectively as proposed due to a lack of methodological and practical approach, which could help the consultant companies control the regeneration projects. With a careful review of the literature of the 'Revitalisation Special Plan', several strengths were found that could co-ordinate the regeneration projects [see chapter three]. The 'Revitalisation Special Plan' emphasises on developing 'socio-economic stimulant zones' which could trigger social and economical regenerations and attract the private sector participation, since the authorities know that without private sector participation, the Municipality of Tehran is incapable of dealing with the widespread deteriorating areas. In this regard, it is important not to merely think of developers when talking about the private sector participation, but take people who live in these areas into consideration as well.

This research is interested in developing a practical work that could contribute to the 'Revitalisation Special Plan' and be beneficial for the practice of urban planning in Tehran. In this regard, 'feasibility' of the work is the most important factor in pushing the research forward. With respect to the feasibility, it is tried to overlap the interest of the Municipality of Tehran with the theoretical framework of the 'Revitalisation Special Plan' to see if there is

anything that can be done to meet the interest of the two as well as the people. With regard to this idea, the problem first was narrowed down to the public open spaces since no 'private' sector is interested in investing on 'public' spaces. At this stage several initial questions rose, including what type of public open space should be considered, which of the problems in the deteriorating urban areas[1] can be addressed by developing this particular type of public open space, and so on. In order to narrow this process, the literature and theories of public open space were studied and it is decided to underline the 'street' as the focus of the research. It is important to highlight the socio-economic aspect of the street to avoid misunderstanding the street with an artery or thoroughfare, which is more suitable for facilitating vehicular movements. The reason for choosing the street network development is that it is the type of public open space that is used mostly in people's daily lives. Also, one could find a deteriorating neighbourhood in Tehran without a plaza or a park, but could not find a deteriorating neighbourhood without streets. Street network development is also the interest of the government, since it can still facilitate the urban transportation in a dense city like Tehran in which transportation is one of the main problems of the city. It can also change the spatial structure of an urban fabric and makes it integrated with or segregated from the surrounding areas. This is an important potential since this research aims to study the 'spatial isolation[2]' of the deteriorating area and makes them more integrated with the surrounding urban fabric. The street has been described as a 'social arena' in the literature, e.g. (Lillebye, 2001), which highlights the socio-economic aspects it can deliver to the society. This research assumed that the pedestrian friendly street network development not only has the potential to release the deteriorating areas from spatial isolation but could also direct pedestrian to and through the deteriorating area, and makes opportunities for the creation of socio-economic interaction; the space that is called 'socio-economic stimulant zones' in the literature.

The notion of 'spatial isolation' is repeatedly used in Iranian literature, e.g. *Renovation Notes for Deteriorated Urban Areas Volume 1-5*, without delivering rigorous evidences in this regard – as far as the author could cover. In fact, the notion of 'spatial isolation' is mostly accompanied by the width of the streets, which is less than six metres in the deteriorating areas. It shows that even in studying the 'spatial isolation' of the deteriorating area, vehicular

[1] These areas include neighbourhoods in which citizenship and human values have decreased and its residents do not feel safe, secure and are not satisfied in their living environment, and their basic civic needs are not fulfilled [see chapter three].

[2] A neighbourhood encounters spatial isolation if it is rarely being visited by strangers in random journeys across the city.

movement is considered as the default mode of transportation, and the factor of 'accessibility' to the space is replaced by the factor of 'mobility' within the space, to the benefit of vehicular movement. In order to clarify this statement, imagine that we have a narrow accessible street in which cars cannot move easily, versus a wide street which is not accessible but cars can move freely within it. With regard to this issue, a high-resolution axial map[3] for the entire city of Tehran was provided to study the spatial configuration of the city and the condition of the deteriorating areas in it. Without exaggeration, this map might be the first piece of strong evidence highlighting the spatial attributes of the deteriorating areas in Tehran, revealing interesting aspects of these areas, which might be in contrast with what was claimed in the Iranian literature. As an example of this, it highlights that the most integrated streets of the whole city crosses the deteriorating areas, and the integration of the deteriorating areas are more than the non-deteriorating areas. However, the local integration of the city reveals the problem of the deteriorating areas making them isolated.

In understanding this research it is important to consider that the approach of the research to the deteriorating area and the research questions are kept at a relatively holistic level to be able to cover cross-scale aspects of regeneration plans; however it has been narrowed down occasionally for studying the deteriorating case study[4]. In many cases, an aspect of the city, such as urban economy, was investigated without digging too deeply into it since it is not necessarily the core of the research. The holistic approach of the research makes a strong and cross-scale platform for further in-depth research. After providing the relevant maps for the city, a correlation between the distribution pattern of commercial land uses and distribution pattern of syntactic measures across the city has been conducted to understand the logic behind the urban economy. The purpose of this stage is to identify the potential streets that can encourage the creation of commercial retailers. Another holistic outcome of the research is a comparative study between different neighbourhoods across the city. In this regard, different spatial attributes of the Tehran neighbourhoods have been compared together to understand the strength, the weaknesses, the potentials and the threats of the deteriorating areas including the deteriorating case study.

[3] A map that is produced by applying the task of Space Syntax and is discussed in chapter four in detail

[4] The deteriorating case study of this research is the Tehran District seven

Talking about streets makes it necessary to study the street life in Tehran as well; however, local references in regard to the Tehran street life were scarce; as far as the author could cover the literature. Moreover, most of the literature that has concerned the street life is western literature, and is not transferable directly into the context of this research. Thus, observational methods were conducted to grasp the sense of the street life in the deteriorating area. These observations could also enrich the holistic approach of the research, although it is limited to a fewer, manageable number of streets, and there is a possibility for further investigation in a separate work.

Additionally, two methods[5], which could help the research to identify the 'socio-economic stimulant zones' in the deteriorating areas, were borrowed from the literature and were adapted and enriched for the case of this research. From the author's point of view these two methods are the most interesting parts of the works since not only they fill the gap between the holistic approach and the socio-economic condition of the deteriorating areas, but they can also make the research transferable to the practice of urban planning. Additionally, the adaptation of these two methods for the case of this research highlights the contribution of this research to the literature. It is important to consider that due to the lack of data and the fact that the PhD research is a 'student work', the final outcome of the research might not be as important as the methodology. In fact, the results of the research might not be transferable to the practice directly but the methodology of the research including the above methods is both transferable and adaptable.

In understanding the author's effort in pushing the research forward as best as possible it would be useful to know that he had to learn the applications of both space syntax and GIS from the scratch using papers without having a chance to take any course in this regard. It is worth noting that the author would have done several things differently if he was familiar with these techniques from the beginning.

1.2. **Summary of the gaps in the literature of urban regeneration in Tehran**

An overview of Tehran's spatial attributes, brought in chapter three of this research, highlights several gaps in the literature of urban regeneration in Tehran some of which are the interest of

[5] The transformability index and the route filtering system which are discussed in chapter four

this research. The summary of these gaps are brought in this section. The literature shows that Tehran is a developing city with the attributes of a polycentric city. However, no strong evidence is presented in regard the notion of 'polycentric city' from the spatial point of view. Also no strong evidence is presented regarding the pattern of spatial expansion of the city. There are also some gaps and paradoxes in the literature of the 'Revitalisation Special Plan' developed by the Tehran Municipality, and some are of interest to this research. Although the 'Revitalisation Special Plan', [see chapter three for further detail about this plan], considered the spatial organisation of the city as the pivotal concept of regeneration plans, no applicable method is proposed to comprehend the spatial organisation of the city as well as the probable role of each neighbourhood in the whole urban system. Without having such methods it could not be possible to consider the deteriorating areas as parts of the urban system to release them from isolation. Additionally, on the one hand, the 'Revitalisation Special Plan' has highlighted the importance of street network development as the main infrastructure of the neighbourhood, and on the other hand it considers the public open space development as the core of the regeneration plan. Here there should be a methodological approach by which it can be possible to make a connection between the street network and public open space development in order to avoid re-experiencing Navvab Highway and urban fragmentation [Figure 3-28].

The 'Revitalisation Special Plan' also highlighted the neighbourhood-orientated approach and the general existing pattern in the neighbourhood including the pattern of public and social life, the pattern of land use distribution, the pattern of accesses and street networks. It also emphasises the importance of the socio-economic stimulating areas in regeneration plans. However, again, no applicable method is proposed in order to vindicate these ideas. There is also lack of methods to evaluate the effectiveness of the regeneration plans. As shown here there are some gaps, which are serious obstacles in the implementation of the 'Revitalisation Special Plan'. In the following part, the approach of this research in bridging the gaps and defining the problem are discussed.

1.3. **Problem definition**

In order to narrow down the gaps and formulate the main problem, the main attributes of the city of Tehran, the literature and history of urban regeneration of Tehran and the approach of the Tehran Municipality to the deteriorating urban areas are discussed in chapter three. Also

some gaps in the literature of urban regeneration in Tehran are highlighted in the abovementioned section which helps in formulating the problem and identifying the position of this research to the problems of the deteriorating urban areas. With regard to problem definition, Figure 1-2 shows the six main contextual factors relating to the deterioration process (Andalib, 2007d). Since the background of the research comes from architecture and urban planning, the interest of the research is mainly around spatial problems of the areas. However, as there is a bilateral relation between spatial aspects and socio-economic aspects the aim is to provide an overview of the social and economic issues as well. This becomes more highlighted when the interest of the research is mainly public open space and their spatial attributes that could also facilitate the socio-economic aspects. Therefore, the main core of the research would be arguments about spatial aspects considering their effect on social issues such as public life and economic issues such as retailers. Considering the interest of the Tehran Municipality in developing socio-economic stimulant zones as the core of regeneration plans, this research will argue that how the spatial intervention to the deteriorating areas should be managed to create more socio-economic stimulant zones. With regard to this idea, the position of this research begins from the spatial studies. Therefore, in formulating the problem it can be said that not having a methodological approach in studying the spatial structure of the deteriorating urban areas in Tehran and linking that to the socio-economic condition of the city has been always a problem and a gap in the literature and is the interest of this research. In the next section the assumptions of the research and the ideas by which this problem can be investigated are presented.

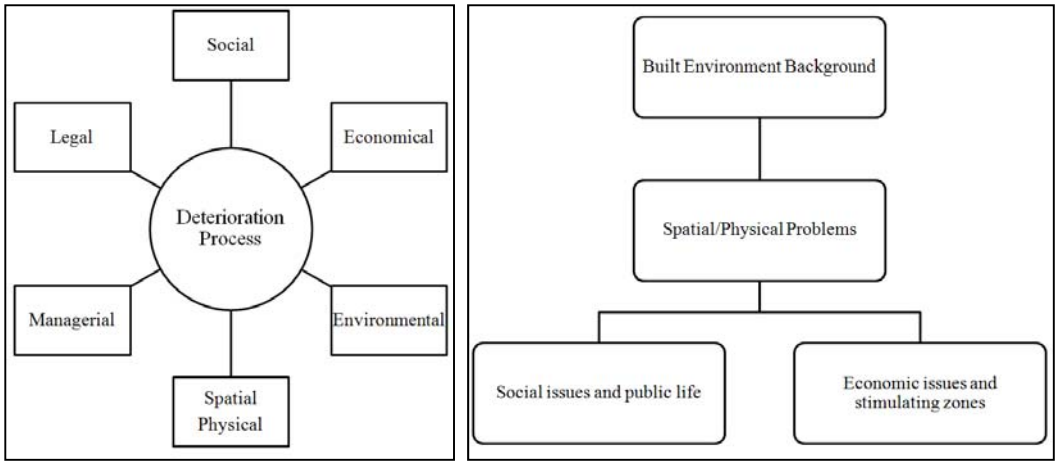

Figure 1-2: The contextual factors in deterioration process and the interest of the research

1.4. **The research assumptions**

Spatial isolation is highlighted as the main issues of the deteriorating urban areas in Tehran; and is the core of this research. The review of the literature [see chapter three] on deteriorating urban areas in Tehran has highlighted the spatial isolation of these neighbourhoods due to lack of accessibility and permeability, which leads to social isolation and economic isolation due to lack of private sector interest in investment. The assumed consequences of being isolated from urban development process are shown in Figure 1-3.

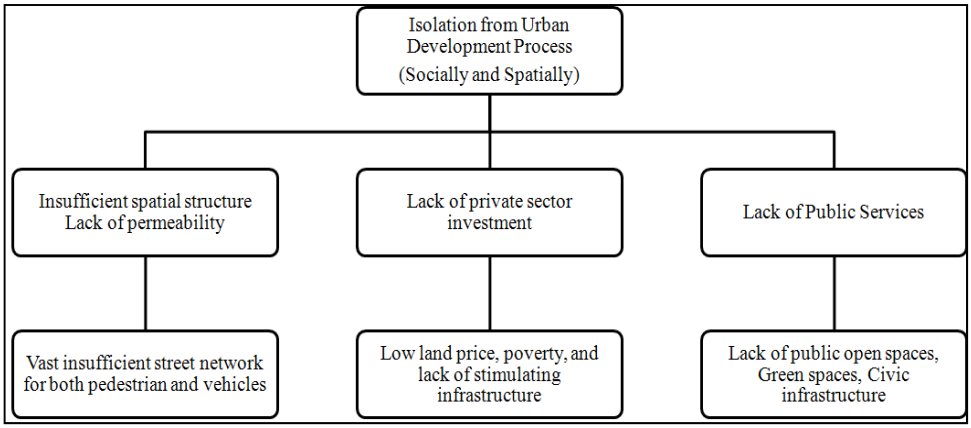

Figure 1-3: Social and spatial isolation of deteriorating areas is the main focus of the research

This research assumes that the regeneration of public open spaces, which could enhance public life, has been absent in the literature of urban regeneration in Tehran to date, and should be considered as the focus of the regeneration plans. It highlights that regeneration projects since the history of the regeneration in Tehran have been limited to renewing buildings or developing highways and other arteries from a traffic point of view. This research assumes that there is a positive correlation between public open space development and enhancement of the urban isolation in the deteriorating areas. Figure 1-4 shows how by investing in public open space it could be possible to trigger the socio-economic and spatial regeneration.

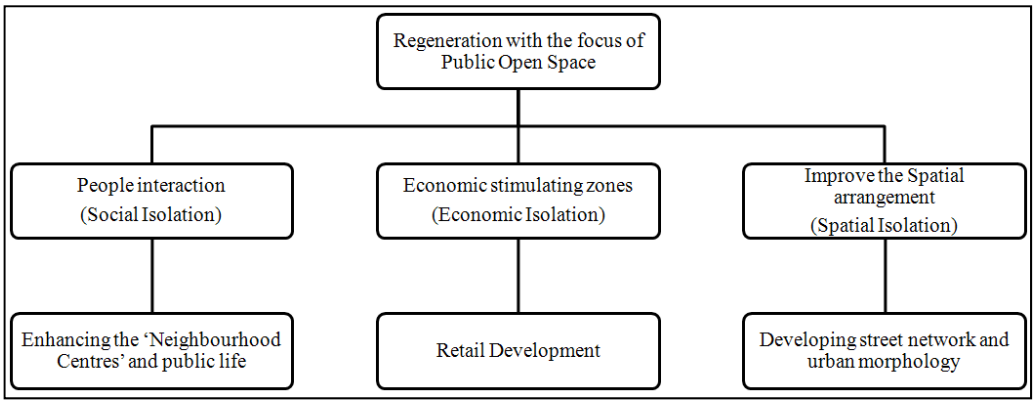

Figure 1-4: Research hypothesis, investing in public open space to trigger socio-economic and spatial regeneration

When it comes to public open spaces, two effective factors come to the mind, the predominant types of public open spaces, and the pattern of public life in the spaces which both depend on the context of the research. The assumption of the research is that street networks including the street plazas, forecourts and corporate foyers, transit foyers, and pedestrian malls are the most predominant type of public open spaces to be found in Tehran. In particular, one could find a deteriorating neighbourhood without parks and green spaces, but could not find a neighbourhood without street networks. As a result the main pattern of public life would be movement, since a street network encourages more movement rather than stationary activities. This is more tangible with reference to the Persian culture where walking has always been a type of leisure, historically in the Persian Bazaar (Brown, 1976). Apart from the effect of the type of public open space, which could encourage the function of it, the pattern of street life, which is more cultural, could be another effective factor in shaping the pattern of use in public open space. For instance, café tables which shape the stationary places in the city and the 'street networks' can be seen in the boulevards in France; or in the plazas in Italy; or in the squares and sidewalks in Britain, this rarely happens in Tehran as a result of social and cultural issues. Investing on the street network would be more interesting when the literature shows that the average area of the street network in the deteriorating area is more than the average street area per neighbourhood in Tehran; the fact which evidences how insufficient street networks are in the deteriorating areas. This matter supports the idea that by investing in street networks and enhancing them, not only would it be possible to optimise the street areas for daily life and transportation, but also more spaces could be released for other types of public open space. So far a summary of the research context, some problems and gaps in

the literature of urban regeneration in Tehran, the interest, assumption and the position of this research towards the problem are presented. In the next part, the research question is discussed.

1.5. **The research objectives and questions**

This research has highlighted that the focus of the Revitalisation Special Plan is to consider the deteriorating urban areas in the spatial structure of the city, in order to create socio-economic stimulant zones and release these areas from spatial and socio-economic isolations [see chapter three]. The research also assumed that the regeneration plans should focus on the public open spaces, since not only can they enhance the spatial structure of the neighbourhoods, but also potentially deliver socio-economic benefits. Throughout a review of the theories and ideas regarding public opens space [see chapter two] and considering the interest of the Tehran Municipality in facilitating the traffic and movement in Tehran, a pedestrian friendly street network as a social arena has been highlighted as the potential type of public open space in Tehran's deteriorating areas [see chapter two] that could enhance the spatial and socio-economic isolations of these areas. In this regard, the main research goals and objectives are to come up with a set of design and planning tool by which the authorities and practitioners could develop a sociable and pedestrian friendly street network. A network which not only could increase the integration of the deteriorating areas into the surrounding urban fabrics, but could also increase the number of pedestrian visits from the deteriorating areas as well as the potential for the creation of retailers and commercial land uses, in order to enhance the socio-economic condition of the deteriorating areas.

In regard to the focus of this research the main questions are:

1. How would it be possible to develop a set of design and planning tools which could study the spatial structure of the deteriorating neighbourhoods in relation to their socio-economic condition in order to optimize the urban regeneration plans?
2. How is it possible to increase the integration of the deteriorating urban areas into the surrounding urban fabric spatially, socially and economically by applying the developed design and planning tool?

3. How the developed design and planning tool could help in the enhancement of the socio-economic condition of the deteriorating urban areas by increasing the pedestrian visit from the public open space of these areas?

The following sub-questions can highlight the different aspects of the research questions:

- What is the spatial condition of the deteriorating areas in relation to the whole city?
- What is the predominant type of public open space found in deteriorating urban areas in which its development could increase the socio-economic and spatial integration of the area?
- What types of activities are taking place in that public open space, and how can they be developed?
- What is the pattern of use in the public open space; and how can we use it as a potential in regeneration plans?

This research assumes that focusing on the pedestrian friendly street network as a type of public open space has the potential to deliver both spatial and socio-economic benefits. In this regard, the hypothesis of the research is:

- ❖ By investing in the spatial configuration and movement as the predominant activity in Tehran's public open spaces and recognising its pattern, it could be possible to make the neighbourhood free of spatial isolation and create movement to and through the deteriorating neighbourhoods, which could facilitate the pedestrian flow and enhance public daily life. As a consequence, it could create more people interaction and enhance the social isolation as well as creating economic stimulant zones such as retailers and commercial land use.

In regard to the main question of the research, the following sub-questions could be proposed considering the research hypothesis and assumptions:

- How is it possible to capture the pattern of pedestrian flow in the neighbourhood?

- How is it possible to manipulate the spatial arrangement of the existing street network in the deteriorating areas in order to direct movement 'to' and 'through' the neighbourhood, easing the pedestrian follow, permeability and accessibility?

- How is it possible to develop a 'street network' rather than a 'traffic road/artery network' without causing urban fragmentation in the deteriorating areas?

- How is it possible to identify the most potential 'streets' with the highest pedestrian flow as the core of regeneration plan of the neighbourhood?

- How is it possible to fit the streetscape and the street life enhancement into the planning regime?

In the next sections, the expected contribution of the research to the field of knowledge is presented.

1.6. **The expected contribution of the research to the field of knowledge**

There are a few studies surrounding the role of public open space in Tehran's regeneration plans, and among them the studies on the pedestrian movement are scarce. Nonetheless, the studies on pedestrian movement usually invest in the effect of the built environment on pedestrian traffic. This study tries to fill this gap through an evidence-based approach not only to invest in pedestrian life but also to highlight the probable effects of pedestrian traffic on the built environment in regeneration plans. It is expected that the outcome of this research contributes to the 'Revitalisation Special Plan', specifically through methodological studies, in order to make this plan more practical and feasible at the implementation stage. For instance, Mansouri (2006) and Andalib (2006) highlighted the role of both spatial organisation and spatial structure of the city in regeneration plans theoretically, but they have not proposed practical methods that could identify these two factors. Having a narrative approach in the literature rather than an analytic approach, which could lead to practical methods and strategies is also highlighted as an 'obstacle' for regeneration plans in the governmental reports, e.g. the literature has a narrative approach to the notion of 'making integration between the deteriorating neighbourhoods and urban fabric' (Andalib, 2007d). In this regard, the first contribution is applying space syntax in a new context, which, as far as the author could cover the literature, has not been studied before from a configurational point of view.

The research also contributed in the literature of urban regeneration in Tehran by providing rigorous evidences and maps in regard to the spatial structure of the city to study the spatial isolation of the deteriorating areas, and provides a strong platform for further investigations. Delivering an evidence-based street network development in the deteriorating areas in Tehran without causing urban fragmentation and re-experiencing the problems of Navva Highway can be highlighted as another contribution of the research in the literature. A methodological street network development in which the underlying spatial pattern and spatial structure of the area has been considered. Delivering an evidence-based street network development that not only could increase the integration of the area into the surrounding urban fabric, but could also increase the number of pedestrian visits from the area and trigger the socio-economic interaction is another expected contribution of this research. Delivering rigorous evidences in regard to the notion of 'spatial isolation', which has repetitively been used in the literature as well as evidenced regard to the Tehran spatial structure, are other expected contributions of this research. Conducting the observational methods and classifying the street life of the deteriorating area within five major classes that are, to some extent, able to be generalised on a bigger scale is also another step in contributing into the literature of public open space use in Tehran. Developing a route filtering system and a transformability index that makes the work transferable and adaptable to the practice is other strengths of this research.

In order to highlight the contributions of the research into both national and international literature, three seminars were organised in Iran by the author[6] to share the outcome of the research and highlight the potential for further researches. Additionally, the outcome of the work has been presented in few seminars for the PhD students in the Edinburgh College of Art, the University of Edinburgh, and the University College of London.

1.7. **Thesis outline**

This thesis consists of eight chapters including introduction and research context, theoretical foundation, literature of urban regeneration in Tehran, methodology of the research, results, discussions, potential application of the method, and conclusion and recommendations. Chapter one is the introduction of the research and tries to briefly discuss what the research is about by providing a summary of the context and literature of urban development in Tehran

[6] The seminars were presented by both Omid Rismanchian and his supervisor, Dr. Simon Bell

which introduces the urban planning regime in Tehran and highlights some gaps in the literature of Tehran urban regeneration plans. After presenting a summary of the gaps in the literature of urban regeneration in Tehran, the research highlights the notions of spatial isolation and public open spaces with the focus of street network development as the main interest of the thesis. Then, it formulates the problem, the research questions and assumptions and defines the position of this research in approaching them. Finally the expected contribution of the research to the field of knowledge is brought.

The second chapter is the theoretical foundation of the research and discusses the literature and theories of public open spaces and the theory of natural movement and space syntax. This chapter is allocated to the theoretical framework of the research which facilitates the investigation into the spatial attributes of the city as well as the socio-economic conditions of the deteriorating urban area. In this regard, the theories and ideas about integrated public open spaces highlight the potential that these spaces could deliver to the Tehran deteriorating areas. Also, this research uses the theory of natural movement, which explores the relation between the spatial configuration and pedestrian movement as well as the attractions within an area such as commercial land use.

Chapter three is about the research context and highlights the trend of urban regeneration in Tehran. This section covers a brief history of Tehran, its expansion and its spatial attributes as wells as the approach of the authorities in dealing with the deteriorating urban areas. As a result, the gaps in the literature of urban regeneration in Tehran are highlighted.

Chapter four is about the methodology of the research and presents the methods by which the research assumptions are investigated. Each method including space syntax, site observations and also statistical analysis is discussed and justified in detail. The result of applying each method is presented in chapter five and then discussed in detail in chapter six. Chapter six includes all the discussions which supports the assumptions of the research and addresses the research questions. The result of these six chapters is delivering a set of design and planning tool for the case of Tehran urban regeneration. The potential application of the developed tool is discussed in chapter seven by applying the tool for the degenerating case study of the research. Finally the conclusion and recommendations of the research are presented at chapter eight. Figure 1-5 shows the thesis outline.

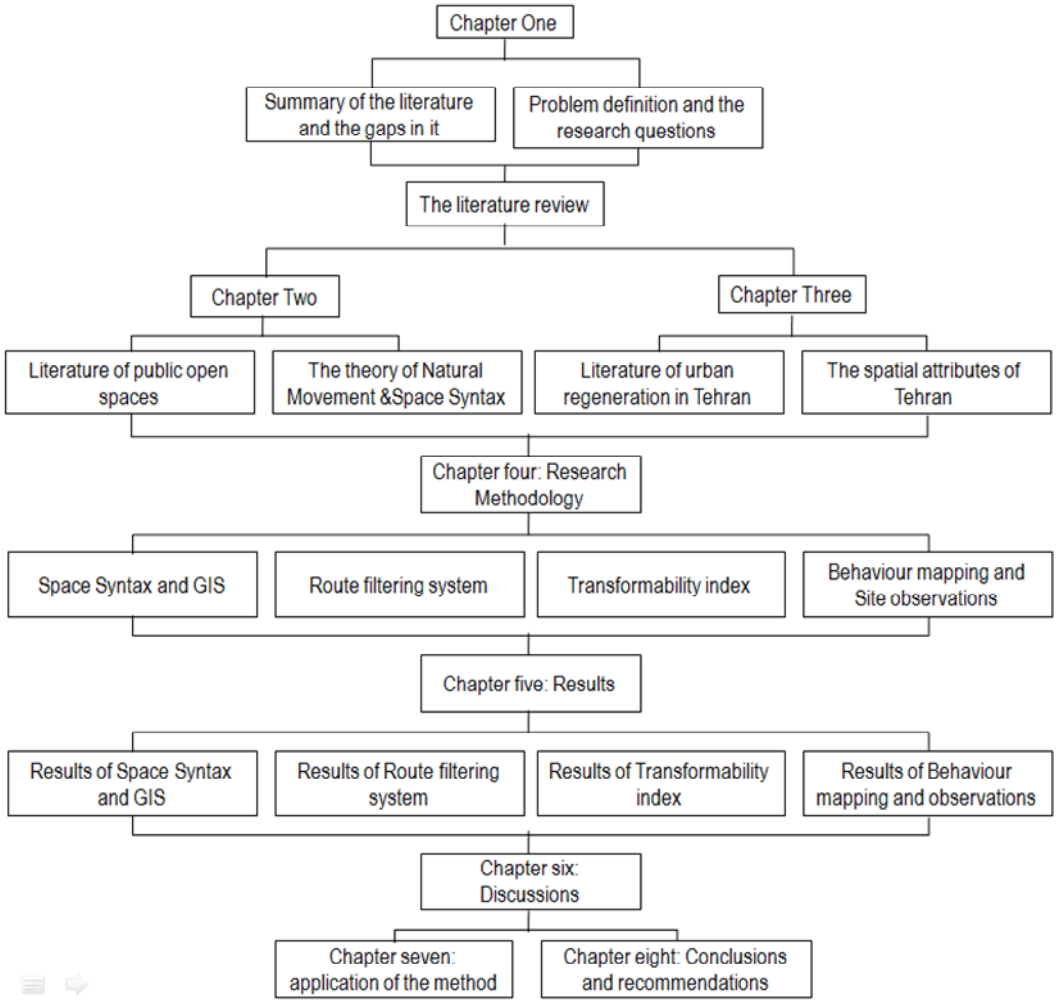

Figure 1-5: Thesis outline

2. Chapter Two: Theoretical foundation for the research

As discussed in the previous section, street network development is the main interest of the government since it could solve some of the traffic problems in the city as well as providing infrastructures for further developments and delivering first aid in the case of natural disasters and crises. However, the Tehran City Revitalization Organization (TCRO)[7] highlights the importance of public open space development as the core of the regeneration plans and creating socio-economic stimulant zones, in order to release the deteriorating areas from socio-economical and spatial isolation (Andalib 2007a, b, c, d). In order to develop a feasible regeneration plan and get the best results with the least amount of socio-economic cost, these two main interests should be wisely connected together. It means that an applicable approach is needed in order to develop the street network as a type of public open space that can facilitate effective civic life as well as releasing these areas from isolation; not just making them arteries that facilitate traffic movement.

Also the spatial organisation of the city is highlighted as the core of the urban regeneration plans as mentioned in the literature review (Andalib 2007a, b, c, d). This research also assumes that the deteriorating areas suffer from spatial and socio-economic isolation and can be enhanced by increasing the integration of the deteriorating areas into the surrounding urban fabric as well as the number of pedestrian visits from these areas. The theoretical framework and the methodology of the research should facilitate the investigation into the pattern of pedestrian movement and its relation to the spatial attributes of the city as well as the socio-economic conditions of the deteriorating area. In order to initially investigate the role of public open space development and the spatial organisation of the city in the regeneration plans, two main theories are discussed in this chapter including the theories and ideas about integrated public open space system, and the theory of natural movement and space syntax.

In this regard, the theories and ideas about integrated public open spaces highlight the potential that these spaces could deliver to the Tehran deteriorating areas. Also, this research uses the theory of natural movement, which explores the relation between the spatial configuration and pedestrian movement as well as the attractions within an area such as commercial land use. Space syntax, which is based on this theory, allows one to study the

[7] TCRO is a section in the Tehran Municipality which is in charge of the deteriorating urban areas.

spatial configuration of the city to quantify the qualitative factors of social life within it, such as people's movements and distribution patterns of land use, crime, or immigrant quarters. However, given that the space syntax method has certain limitations, this research has also applied observational methods and conducted surveys including several site observations and behaviour mapping exercises in the case study of the research. In the following sections the theoretical framework of the research are discussed.

2.1. **International experiences in urban regeneration**

The role of public open spaces in urban regeneration is highlighted in the literature and is mainly dichotomised in regeneration of the historic parts of the cities and regeneration of the none-historic and deprived areas of the cities (Andalib, Haji Ali Akbari, 2008). The history of urban regeneration in Europe and especially in the UK is mainly in the historical part and the 'old town' of the cities. In this case, the focus of regeneration plans was to revitalize some parts of the cities through building conservation, developing a pedestrian-friendly and mixed-used area, traffic calming and attracting more retails and commercial land use to the area. The outcome of this approach is an area which facilitates social interactions and attracts people from different part the cities and provokes economic regeneration and enhances the condition of the area physically, socially and economically [Figure 2-1] (Andalib, Haji Ali Akbari, 2008).

Figure 2-1: Regeneration of the old town in Manchester, UK (Andalib, Haji Ali Akbari, 2008)

The regeneration of urban areas is not limited to the historic parts of the cities and in many cases it includes the none-historical parts of the cities. The history of these projects shows that it happens when the authorities have to deal with vast deprived areas in the cities which are incapable of regenerating itself (Andalib, Haji Ali Akbari, 2008). In this case, there is usually no will from the residents of these areas and nor an attraction for the private sector to invest in the none-profitable deprived areas. In these cases, the regeneration plans are dictated by a determinant authority which has sufficient recourses. An example of this is the direct intervention of the French government in Paris by Hussmann at the 19th century. Another example of this case is regeneration of cities in Peru in which the authorities including the city councils directly intervene into the urban areas and pushed them towards a pre-planned condition. This approach provokes many legal problems including the ownerships of the plots and buildings and creates many conflicts between the residents and the authorities. The same thing happened in the USA at 1954 when the authority of the local governments in demolishing the low-income neighbourhoods in the benefit of developing affordable housing increased. This approach was decreased by the residence of the residents at 1964 and the approach towards urban regeneration was shifted to conservations and socio-economic revitalization (Andalib, Haji Ali Akbari, 2008). The later approach was applied in the Hong Kong since the authorities adopted regeneration plans from the UK. They believed that the regeneration plans should be collaborative plans which includes residents and considers the socio-economic condition of the areas as the core of the regeneration plans [Figure 2-2] (Andalib, Haji Ali Akbari, 2008).

Regardless of whether urban regeneration is happening in the historic parts of the cities or none-historic parts, or which approach is being used in dealing with the deprived areas, public open spaces and enactment of the areas socially, physically and economically has been always the core of the plans. In the following parts the attributes of public open spaces and the benefits they can deliver in urban regeneration plans are discussed in detail.

Figure 2-2: Urban regeneration in the Hong Kong

2.2. **Public open space**

This research assumes that public open space development should be the focus of the regeneration plan in order to deliver both spatial and socio-economic benefits to the Tehran deteriorating areas. In order to highlight the potential of this assumption, the characteristics of public open space should be studied as well as the potential of the street networks in fulfilling these characteristics.

2.2.1. **Definition of public open space**

Public open space is defined in so many ways however; they all share similar points of view. Here an overview to the definition of public open space is presented as well as the most important attributes that can be derived from it. In terms of terminology, it has two important components including 'public' and 'open' space. *The Oxford Dictionary of English, 2nd edition revised*, defines 'public' as "open to or shared by all the people of an area or country" or "provided by the state rather than an independent, commercial company" (Oxford University, 2010b). The *Compact Oxford English Dictionary of Current English, 3rd edition revised*, defines 'public' as "available to the people as a whole; or involved in the affairs of the community"

(Oxford University, 2010a). The key point in this definition is the availability to the public for community use.

A dictionary of environment and conservation defines 'open space' as "public and private land that is undeveloped, which often retains its natural vegetation, and is usually used for recreation or as a reserve to protect natural areas" (Park, 2007). Although open space here is defined as 'undeveloped', the definition of 'open' could help to have a clearer idea in this regard. The *Oxford English Dictionary of Current English, 3rd edition revised*, defines 'open' as "allowing access, passage, or view; accessible, receptive, or available" (Oxford University, 2010a). The key points in this definition are firstly being public or private land; and secondly being available and accessible physically or visually. The term 'open space' can be misunderstood since 'open space' implies absence that the space is left open or vacant in the spatial fabric of a city.

"Some open spaces are indeed just that. But they are also much more, and the term encompasses a far greater diversity of types, sizes, shapes, and functions than its simplicity implies. Open space might be your yard, the park, the playfields or the garden down the street, the square at the town centre, the river corridor that runs through town, or the prairie at the edge. It might be 'open' but also complex and highly developed (engineered and built) to perform particular recreational, aesthetic, agricultural, practical, or ecological functions" (Girling, Kellett, 2005, p57).

"Open space is defined in the Town and Country Planning Act 1990 as land laid out as a public garden, or used for the purposes of public recreation, or land which is a disused burial ground. However, in applying the policies in this guidance, open space should be taken to mean all open space of public value, including not just land, but also areas of water such as rivers, canals, lakes and reservoirs which offer important opportunities for sport and recreation and can also act as a visual amenity" (ODPM, 2002, p13).

The concept of 'public space' has a multiplicity of meanings in the respective literature and has various meanings in "different societies, places and times" (Smith & Low, 2006, p. 4). Brodin (2006) divided the concept into two different perspectives including 'metaphorical public space' and 'literal public space'. The 'metaphorical public space' represents a "mental space" for communication and discussion among individuals and the 'literal public space' represents a physical space one that is studied by architects and geographers. Both terms can, however, inform each other (Brodin, 2006). Goodsell (2003, p. 367) provided another interpretation, shaping the concept into a threefold perspective: a 'political philosophy and democratic theory' which has its focus on the public discourse and political arena; "urban

planning and design", which deals with the physical environment, such as gardens, parks, streets and plazas; and the 'political interpretation of architecture', which is the interpretation of public buildings and the demonstration of political power in public spaces (Silveirinha de Oliveira, 2012).

This definition, which covers the attributes of public open space, outlines that it is publicly or privately owned lands and spaces which are open, available and accessible for the public use (Metropolitan Transportation Authority, 2007, Sumowicz, 2001, Garcia-Ramon, Ortiz & Prats, 2004, Rafyian, Sifayee, 2005, Tibbalds, 1992).

2.2.2. **Public open space classifications**

Public open spaces are for interaction, recreation, and amusement as their main purposes have often been associated with parks and green spaces in the West. Public green spaces have existed in western communities for a long time, and in some western cities green spaces can occupy more than 20% of the total land use. However, conventional parks and green spaces have been recently introduced into Islamic cities such as Iran (Ardalan, 1980). Most parts of the Iranian cities are located in the semi-arid areas and usually there is no substantial public green space in traditional cities except in the main ones like Isfahan with the great Naghsh-e-Jahan Square. In addition, public green space was not so common in cities due to inadequate water resources and the only main green space that to be found in the traditional cities was the Persian garden, which was a private land, used mostly by the kings. Therefore, in order to have effective public open space management, a clear classification of different types of public open spaces is important (ODPM, 2002). Different authors have classified public open spaces from their desired points of views; some classified them according to their functions, scales, forms and so on. Here, some of these classifications are presented. The key point here is that no matter from what points of view the public open spaces are classified, they all share similarities that highlight the complexity of public open spaces.

Bell et al. (2006) presented a broad and comprehensive classification of open spaces. They have classified public open spaces in nine categories, including parks and gardens; natural and semi-natural spaces; green corridors; outdoor sports facilities; amenity green spaces; provision for children and young people; allotments, community gardens and urban farms; cemeteries, disused churchyards and other burial grounds; and public space. They also have

introduced sub-categories for each of these classifications to increase their accuracy. Figure 2-3 shows a typology of public open space (Bell, Montarzino & Travlou, 2006).

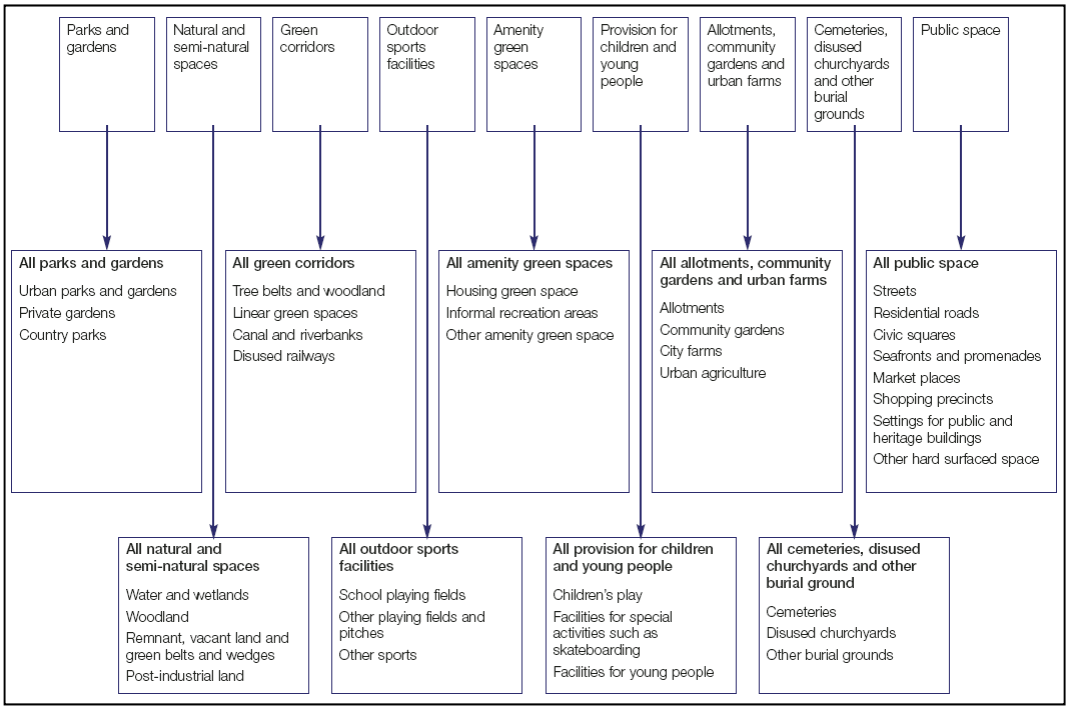

Figure 2-3: Public space typology, (Bell, Montarzino & Travlou, 2006)

ODPM (2002) classified open spaces in ten categories, and divided each category into sub-categories to cover a variety of open spaces. These categories include parks and gardens; natural and semi-natural urban green spaces; green corridors; outdoor sports facilities; amenity green space; provisions for children and teenagers; allotments, community gardens, and city farms; cemeteries and churchyards; accessible countryside in urban fringe areas; and civic spaces (ODPM, 2002, CABEspace, 2005).

Despite ODPM and Bell et al. reports, whose classification cover the variety of public open spaces, Croucher et al. (2007) classified only green spaces as a type of public open space. They have classified green spaces in nine categories including public parks and gardens; private and domestic gardens; community gardens and allotments; urban planting and landscaping; cemeteries; sports fields; green path/routes and trails; brown-field sites; and national parks and other wilderness environments (cited from (Bell et al., 2008). CABE (2005) has also classified green spaces. The role of parks, domestic gardens, marshes, woodlands, tree-lined streets, cemeteries, squares, sports fields, allotments, green corridors, play areas and farms are highlighted as different components of urban green infrastructure. Girling et al.

(2005) classified urban open space according to the scale from lot to region. Figure 2-4 shows this classification in six different classes, which are lot, block, street, neighbourhood, community, and region.

Scale	*Example*
Lot	Yards
	Courts
Block	Play lots
	Commons
	Pocket parks
Street	Rights of way
	Medians
	Planting strips
Neighborhood	School yards
	Neighborhood parks
	Playgrounds
	Drainageways
Community	Community parks
	Play fields
	Smaller conservation area
	Greenways
Region	Regional parks
	Large conservation areas
	Greenways
	Waterways

Figure 2-4: Open Space across Scales, (Girling, Kellett, 2005)

Marcus et al. (1998) presented the concept of 'modern urban plazas', versus the conventional piazza as a type of public open space that can deliver variety of benefits to people's daily lives if considered more carefully in our cities. They have classified it in six categories including the street plaza; the corporative foyer; the urban oasis; the transit foyer; pedestrian and transit malls; and grand public places. They have also divided each category into different sub-divisions to highlight the value of each of them.

The broad classification of different types of public open space from green spaces to streets and plazas can help the research to identify the complexity of public open space development in urban regeneration plans. It shows that if the TCRO wants to enhance the lack of public open spaces in the deteriorating areas, it is vital to identify the benefits that each of the presented types can deliver to manage the development. Identifying a priority in public space development can optimise the cost and benefits (Rogers, 2005). For instance, development of a green park in a dense area might be a difficult task in short-term action plans, but

developing small plazas or greened streets may be able to deliver considerable benefits in the same period of time with a lower cost.

2.2.3. **The integrated public open space system**

Public open spaces can deliver several values such as economic, health, social, environmental, physical, and managerial values (Bell, Montarzino & Travlou, 2006). It is obvious that it depends on the type of public space, as some values can be delivered more in one type over others; some spaces can work in the local catchment area and some can work in a citywide or regional catchment (CABEspace, 2005). Although individual public spaces are important, many studies have emphasised on an integrated open space system which can create an accessible, sustainable and adoptable open space network; the system which can deliver social, economical, ecological and health benefits (CABEspace, 2005, Taylor, 2008, CABEspace, 2007, Jackson, Kochtitzky, 2000, Groom, 1990, Ward Thompson, 2002, Ellis, 2002). It is important not to assume that just by developing single parks, plazas, and pedestrian malls, public open spaces in the city can be enhanced. These single actions can only be as beneficial as they should be, so long as they are considered as a part of bigger open space infrastructure (CABEspace, 2005).

The concept of integrated public open space has been developed since 1965 and tries to make integration between pedestrian areas through the combination of separate pieces of land, such as mini parks, playgrounds, and urban plazas, into a system – at least in theory (Marcus et al., 1998). It was developed as a position against the urban fragmentation caused by modern urbanism, suburb and sprawl development in order to create a compact city. Rogers (2005) believes that the redevelopment of urban open spaces into an integrated system can play a crucial role in revising the process of fragmentation. This is a clear integrated network of open spaces which not only can connect different urban spaces to each other across the city, but also link communities and neighbourhoods as well, with people within localities to their home, school and other destinations. It is a network of connected public spaces that offers people different choice when deciding to make a local journey in daily life. This system is a linked network of multi-functional public open spaces that can enhance the existing areas around new community centres and housing development [Figure 2-5] (Rogers, 2005, Ward Thompson, 2002).

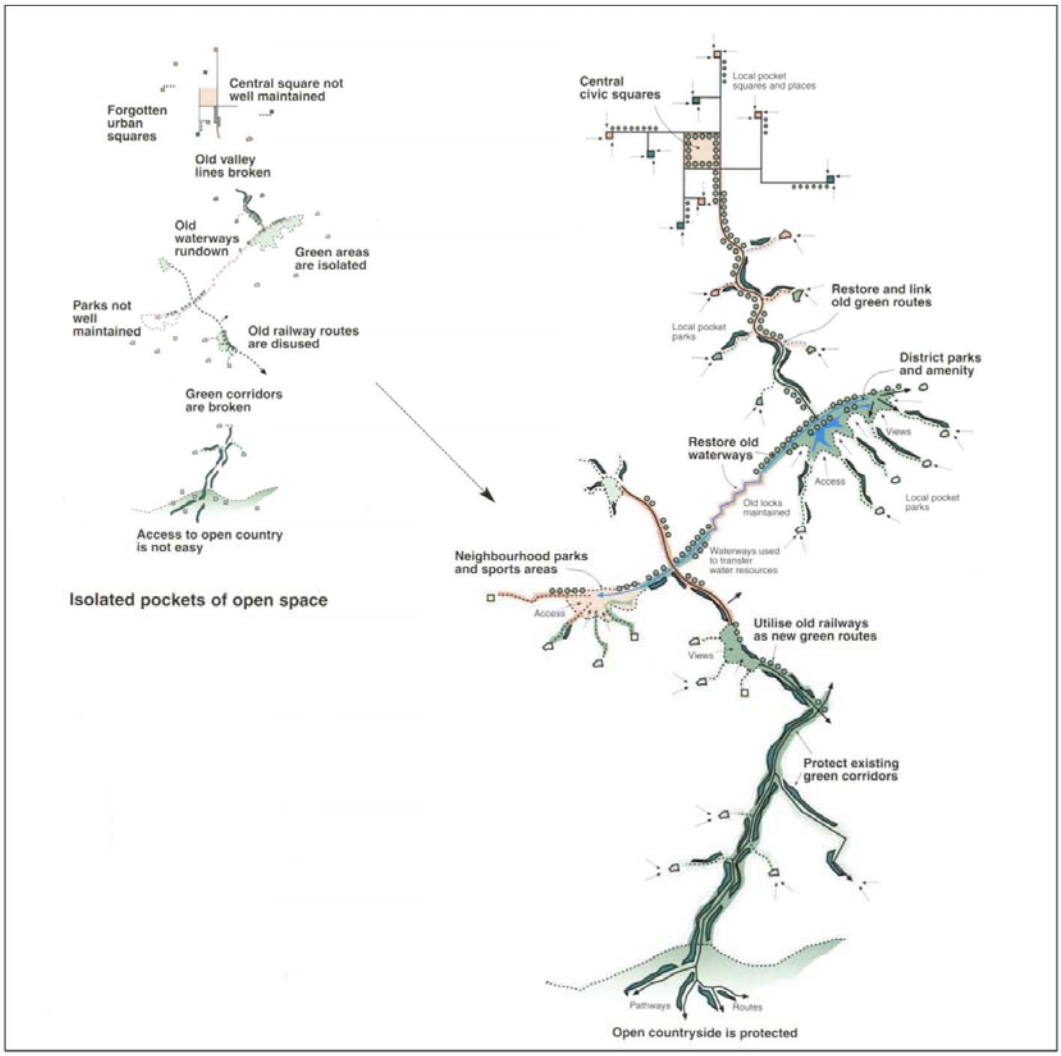

Figure 2-5: Cities and towns should be designed as networks that link together residential areas to public open spaces and natural green corridors with direct access to the countryside, (Rogers, 2005)

This system is a network of open spaces integrated with the surrounding street pattern, and access points placed at major junctions. In this system, safe and attractive routes are linked with the street network, encouraging people to travel to work and school or to access local services on foot or by bicycle. This system also makes it possible to bring all the components of open space together, from small ones such as footpaths to the larger ones such as parks, in one plan (CABEspace, 2005, Groom, 1990).

Girling et al. (2005) believes that such a system can integrate urban spaces into the surrounding urban environment and landscape and deliver a more sustainable ecosystem. It is an interconnected network of open spaces, including inner city open spaces and natural areas that provide many vital services; sustains, and enriches the quality of, life; conserves natural

ecosystem values and functions; and provides associated benefits to human populations (Girling, Kellett, 2005). In their book, *Skinny Streets and Green Neighbourhood*, Girling and his colleagues defined the 'green network' and the 'grey network' as the main components of integrated open space. They define the 'green network' as a network of inner-city open spaces, predominantly in the public realm, which are important elements of land use and community planning and design. It is a flexible concept that primarily includes the urban elements of parks, greenways, and natural areas. It might also include many other green elements, such as parkways, green streets or other physical elements of the city that can be planned alongside streets and development. Following the 'green network', they define the 'grey network' as the urban circulation systems including streets, transit ways, bikeways, and pedestrian pathways, which at the neighbourhood scale serve people's daily needs from transportation to socialising, [Figure 2-6] (Girling, Kellett, 2005).

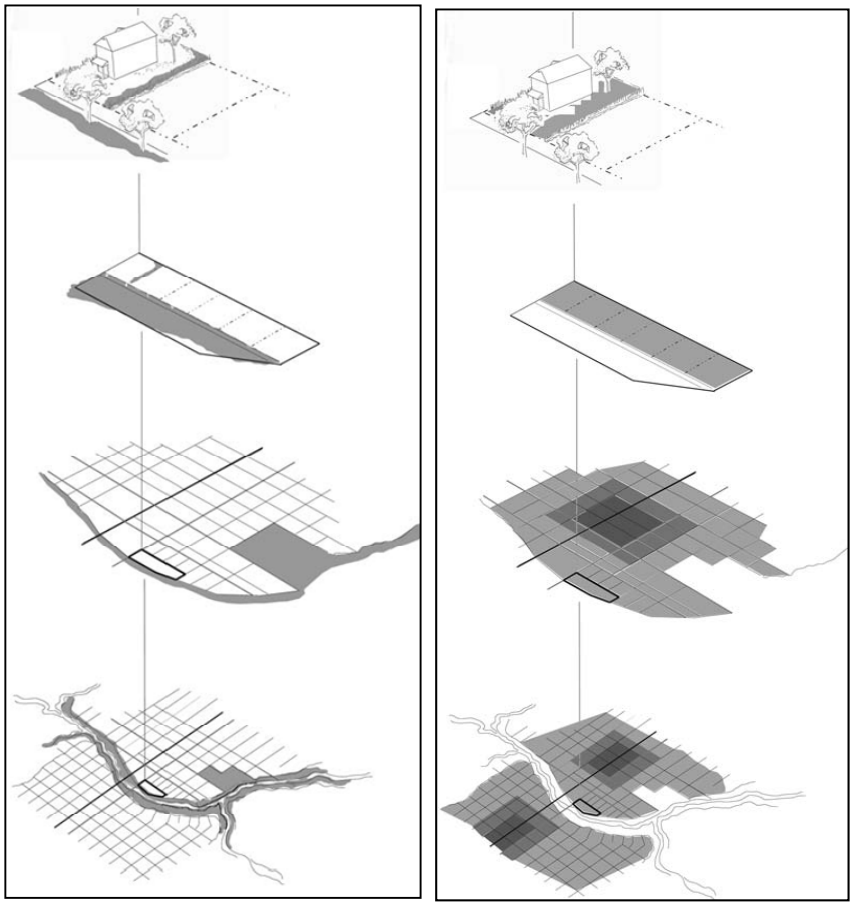

Figure 2-6: The Green Network (Left) and The Grey Network (Right) shown across scales, (Girling, Kellett, 2005)

This concept can deliver considerable benefits. It can create a well-connected network of open spaces and a compact neighbourhood, which encourages people to walk and make the community stronger (Rogers, 2005); a neighbourhood which is called the 'green neighbourhood' (Girling, Kellett, 2005). This system makes an opportunity to create spaces which are more cohesive socially, avoiding a disparity of opportunity and promoting equality and social solidarity. This idea can be achieved best if it is developed based on the life of the people who are living in the space (Rogers, 2005, Ward Thompson, 2002).

This system also delivers ecological benefits which values the ecosystem's components, from parks to a small urban-tree (Girling, Kellett, 2005). An example of this integrated system is developed in the Minneapolis Park System, USA, by making a 'green network' which links all the public open spaces such as green spaces, parks, and plazas by boulevards, avenues, streets and parkways. This case has succeeded to bring an accessible and connected network for public use that includes many miles of walking and cycling trails, parks, gardens, nature reserves, play areas, recreation areas, beaches, lakes and parkways, and a range of historic properties (CABEspace, 2005).

2.2.4. **The importance of urban linear elements**

The review on public open space highlights the gaps for future research, some of which are relevant to the topic of this research. Accessibility to public open spaces, especially in everyday life, is repeatedly highlighted as a gap that needs to be addressed (Bell, Montarzino & Travlou, 2006, Jackson, Kochtitzky, 2000, Morris, 2003). In this regard, the role of investing in different linear elements of open space systems to fulfil these gaps is highlighted in this section.

The linear components of an integrated open space system are usually associated with green corridors and routes, which are usually located in the urban fringe or rural areas. However, it is important to consider all types of linear elements such as the street networks and green streets to integrate open spaces with the inner city and housing areas (Groom, 1990). Ward Thompson (2005) reports that most of the visits to public open spaces, including green spaces, are located just five minutes' travel from home, which shows the importance of the proximity to the public open space. The prime method of enhancing linear elements of the open space system, e.g. street networks and inner-city green corridors, is to integrate public

open spaces into housing spaces, as well as increasing the accessibility and the availability of public transport, local services and facilities (CABEspace, 2005, Ward Thompson, 2002, Westbury, 2007). These linear elements can create a wide range of accessible recreational facilities in the neighbourhood (Groom, 1990), as well as delivering health and environmental benefits by increasing the accessibility to the public open space (Bell et al., 2008). They can also help to create a stronger society and a more sustainable community through connecting the neighbourhoods together, as well as consequently increasing the interaction of people (CABEspace, 2005, Rogers, 2005).

A well-designed linear network can create an environment in which people can freely move without aggravation from noise, pollution, danger or other harmful side effects. Although an individual may use only a small part of the network, s/he gains access to the whole system and knows that s/he can use all of its parts (Groom, 1990). Having pedestrians and their daily lives as the focus of an integrated open space system highlights the importance of the movement-support elements. This can create a walkable community and may change the microclimate in the surrounding environment of the pedestrians and create a healthy environment for them (Jackson, Kochtitzky, 2000, Marcus, Francis & Russell, 1998). It can change the traffic-orientated road hierarchy and create a more reasonable approach to urban corridors as a type of public open space (Apelt, 2003). The linear elements can work as human-friendly transport linkages, which bring the local land uses such as schools, parks and health-care centres together and reduce the need for car-orientated transportation (Rogers, 2005). It also can create a safe place for vulnerable people, e.g. children, by supporting the public transportation to the destinations such as parks and schools (Westbury, 2007).

Linear routes can be valuable, particularly to people who find that movement, notably walking, is an important part of their leisure activities (Groom, 1990). It can enhance people's immediate environment and improve the quality of their daily physical activities (Jackson, Kochtitzky, 2000). Being in the open space can have a restorative effect, however, not everyone can find the chance to benefit from exposure to the open space. A well-designed network can provide an accessible restorative public open space in the everyday space of the residents of housing areas (Morris, 2003). It enhances the perceptions of well-designed access to public transport options and local land uses, which are associated with a higher likelihood of walking (Bell et al., 2008).

Enhancement of the linear elements can improve the legibility of the neighbourhood as a result of a well-designed and integrated open space network (CABEspace, 2005). It can also increase the townscape and the quality of public open space, and increase the residents' satisfaction of their living area (Westbury, 2007). Improvement of the quality of the widespread linear elements, e.g. streetscape, can increase the distinctiveness against uniformity, connection against isolation, function against uselessness, and conviviality against exclusiveness (CABEspace, 2005). Having the green elements, e.g. trees and shrubs, in the network can provide visual access to the natural elements, e.g. tree canopies, for the residents of the neighbourhood and increase their satisfaction and wellbeing, as well as the quality of outdoor activities (Bell et al., 2008, Morris, 2003). The trees in the inner-city green corridors such as greened streets can enhance the streetscape and improve the expression of the street character as well as providing a function by their shade (Apelt, 2003). If a network accompanies green elements, it can enhance the microclimate by offering cooler and cleaner air (Taylor, 2008, Apelt, 2003). They can also decrease the heat islands by increasing the shade on the hard surfaces to moderate the microclimate of the neighbourhoods (Bell et al., 2008, Jackson, Kochtitzky, 2000). A well-designed network can also reduce the stress of the population, especially with short-term anxiety and mental fatigue, and reduce aggressive behaviour and develop happiness by increasing people interaction (Bell et al., 2008).

Although the environmental attributes found to be associated with walking to and from places differ from those associated with walking for exercise or recreation, developing the linear elements can improve the level of physical activities through increasing accessibility to public open space (Bell et al., 2008). They can improve the quality of, and access to, neighbourhood open spaces and contribute to increase the amount of outdoor activity for people (Bell et al., 2008, Morris, 2003). A well-designed integrated network of open spaces invites a wide range of users, from the youth to the elderly, and creates social cohesion with more social activities and delivers more social benefits (Bell et al., 2008). They can increase the social life and make a better community by enhancing the accessibility and the quality of outdoor activities as well as the image of the area and attracting investment. They can contain different types of daily activities and improve the quality of outdoor life especially in the housing areas (CABEspace, 2005). Having such a network can provide a long-term vision for the design and management of land as environmental infrastructure, as well as planning programs for environmental improvement in urban areas (CABEspace, 2007, Groom, 1990).

2.2.5. **Different types of urban linear elements**

In order to focus on the public open space development in Tehran, the concept of integrated open space system has presented different types of public open spaces that can be considered in this system. The linear elements of the system are highlighted as the interest of the research, yet in the literature of public open spaces, different types of linear elements with specific attributes and expected functions are shown. It is important to focus the interest of the research one step further to be able to make a priority of public open space development in Tehran, and investigate the quality of public life in it. Therefore, different types of open spaces that can be considered as part of the linear network of the system are discussed in this part. Through the literature, green corridors, linear parks, greened streets, street plazas, shared-use spaces, pedestrian malls, and pedestrian-friendly street networks will be presented here.

Green corridors, which usually follow the rivers, national walking trails, renewed railways and other existing routes, are multi-functional places that should be considered as part linear networks. They usually provide access to the countryside and deliver a high level of environmental benefits such as sustainable urban drainage systems as well as diverse habitat types and activity zones. They can also provide continuous routes of open space through urban areas and integrate the cities to their surrounding environment (CABEspace, 2005). Green corridors can serve a wide range of recreational facilities and offer access to the conventional parks, woodlands and natural environment as well as supporting environmental-friendly transportations such as cycling and walking (Bell et al., 2008, Groom, 1990).

Another type of linear elements is the linear park. The concept of the linear park dates back to Olmsted's plans for green parkways' function of preparing a visitor's mental image as they approach the park. However, it has evolved to become its own complete form of green space. Linear parks are publicly accessible natural landscapes in an urban or suburban setting whereby its length is more considerable than its width. It is a particular type of green space, which may be located in any kind of neighbourhood (by density or income) or may straddle several neighbourhoods. It easily can follow linear features such as railroads, water channels, or riverbanks (Marcus et al., 1998). Its linear form makes a recreation space which encourages a lot of activities in people's daily lives such as walking, cycling, and jogging and creates a place with a potential for enhancing health. Its elongated perimeter makes a great park access from adjacent neighbourhoods in comparison to conventional or rectangular

parks (Marcus et al., 1998). The challenge in developing such an urban corridor is that it is not easy to be expanded in the highly dense areas of the city, although its expansion can be considered in new housing developments. Thus, in the case of Tehran's regeneration plan, it could be an option for the areas that need to be demolished and rebuilt again, but expansion of the neighbourhoods that should be revitalised is not an easy task.

Another linear urban space that can be considered as a component in the network is the greened street. It is a street with trees planted in a linear pattern at regular intervals whose branches reach across the street and create a canopy over both the road and sidewalks (Randall, Churchill & Baetz, 2003). The proportion between the street's width and the height of the trees are two important factors in achieving this form. This form can be complimentary to other existing routes in the neighbourhood, especially the organic ones, and this makes this type of urban corridor ideal for developing or expanding in most areas of the city.

Street plazas are another type of urban element that can be considered in this system. It is a kind of urban space that is used for brief periods of sitting, waiting and watching and tends to be used more by men than women. It is immediately adjacent to the sidewalk and closely connected to the street (Marcus, Francis & Russell, 1998). They can be used as linger nodes and gathering places as well as spatial joints between different routes in the open space system. Its components include: a seating edge; a widened sidewalk; furnishings such as seating blocks, which can be steps used for viewing; bus stops, which can be well furnished with benches, shelters, kiosks or litter bins; the pedestrian link, an outdoor passage or alley, usually narrow or green, that connect to blocks; the corner sun pocket, which is a part of a building designed to open up a small plaza where two streets meet; and finally the arcade plaza, a sidewalk widened by means of an extension under a building overhang (Marcus, Francis & Russell, 1998). Street plazas owe their compatibility with other areas to their small-scale components, which make them easy to be developed or expanded upon in the neighbourhood and deliver the benefits of public open space to people's everyday lives.

Shared-use space can be another component of the linear network. The theory behind shared space is to encourage drivers to reduce their speed due to the high chance of people crossing, and whereby it's generally less clear, who has right of way. Users of the space have to negotiate its use by an increased awareness of other users and their possible intentions. The main element of these spaces is a shared surface that removes the presumption that the

car driver has the right of way (CABEspace, 2008a). This approach, which is influenced by how people understand and use the space, can be effective where vehicle flows and speeds are low, such as in residential neighbourhoods (CABEspace, 2008a). Plants, especially trees, are welcomed in this kind of space, though planting should not be a barrier for pedestrian and vehicle movement, as their movements should remain flexible in the space.

A pedestrian or transit mall is another urban corridor which could be considered in this network. It is a closed street which has modified paving, either eliminating or narrowing the pre-existing roadway, increased planting, and these are usually located in downtown commercial zones. After modification it becomes a place for people to stroll, sit, eat, and watch the activity around them. It can be a transitional pedestrian area; a street completely closed to traffic, a mixed mall; a pedestrian mall that allows limited use by automobiles during certain hours, or a transit mall; incorporating public transit, allowing for buses (Marcus, Francis & Russell, 1998). An example of these spaces from the research context, Tehran, is the Persian bazaar with hierarchy of movement and stationary spaces in which different activities happen simultaneously (Ardalan, 1980).

Pedestrian-friendly street networks are an important urban element that could play the most effective role in the linkage network of the open space system. It is important not to consider the streets just as an artery and transportation access, but as a part of public open space. ‘Civilised street’ is the term that can be seen in CABE’s publication for such a street network. It is a place where the needs of people are prioritised over cars, which has different benefits such as creating stronger communities by increasing social interaction; safer communities by making an equality right of use in the space; health and wellbeing by encouraging play and active travel in the daily routine; a stronger economy by increasing opportunities for business; and environmental sustainability by encouraging cycling and walking (CABEspace, 2008a). Figure 2-7, shows the hierarchy of users should be considered in the ‘civilised street’ (Department for Transport, 2007).

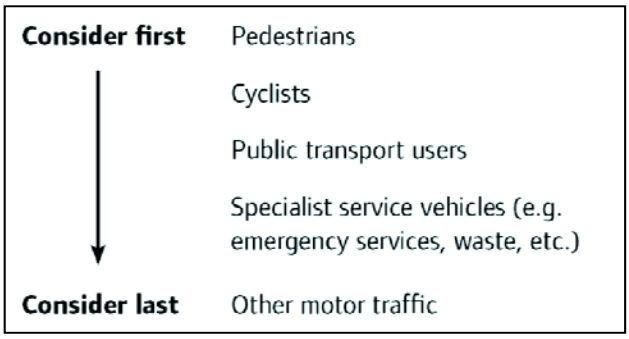

Figure 2-7: User hierarchy, (Department for Transport, 2007)

This kind of urban space is important for the aim of this research as it shapes the main space's everyday activities. Considering the value of the street as a person's immediate surrounding environment, its enhancement can play a vital role in improving the quality of outdoor activity, especially in people's daily lives (Ward Thompson, 2002). Developing pedestrian-friendly streets with active frontage can make an immediate impact on people's lives and play a vital role in facilitating their daily activities by delivering socio-economic and environmental values to the neighbourhood (Rogers, 2005).

2.2.6. **The Street**

In this part the importance of the street network's development and its socio-economic effects on regeneration plans, as well as its spatial potential in releasing the deteriorating areas from isolation, are discussed. In the abovementioned parts, different types of street, including greened streets, street plazas, and pedestrian friendly streets, were brought into attention as important parts of the integrated open space system. In this part the importance of street network development as a type of public open space in Tehran's regeneration plan is discussed. First, in order to distinguish the 'street' from the 'road', 'thoroughfare', 'artery', 'pathway', definitions, expectations and functions of the 'street' are brought into light. Afterwards, based on the different expectations of the 'street', the benefits of street network development, as a part of regeneration plans in Tehran, are focused on.

2.2.6.1. **A brief history of the street**

The history of the street goes back approximately 8000 years. Throughout history, the function and the expectations of the street have changed, as well as its components. During the middle ages, the main function of the street was transportation. At this period of time, streets

developed where they were needed, mainly as a result of architectural developments and building constructions, with consideration of the topography (Lillebye, 2001). Throughout the Renaissance era the street's architectural significance became a subject of artistic importance. At this time, the street found a new role as an architectural phenomenon and a generating urban element. In the Baroque era this role reached to its peak in the layout of the new Paris by Baron Hausmann in the middle of the 19th Century (Lillebye, 2001). By the beginning of the 20th Century, the traditional city form proved to be unsatisfactory and as a consequence the street was abandoned, both functionally and architecturally. The traditional densely built up city with an urban pattern of streets and squares was replaced by a fragmented urban space with individual buildings and a network of roads and motorways connecting the various zones of the open city (Lillebye, 2001). Le Corbusier's statement clarified the modernist's point of view to the role of the street in the modern cities. He said: "Our streets no longer work. Streets are an obsolete notion. There ought not to be such a thing as streets; we have to create something that will replace them" (Moughtin, 2003, p129).

The approach of the modernists is criticised later in 1960s and 1970s by several authors such as Jane Jacobs in her book *The Death and Life of Great American Cities,* and Jan Gehl in his book *Life Between Buildings,* by emphasising on the social aspect of the street and street as a socio-economic arena (Gehl, 2006; Jacobs, 2000). A historical review of the street reveals that both its form and the function have changed during time, causing a well-defined and established framework of the street's definition, function and expectations in the present day. In order to highlight the role of the street in this research, it seems important to point out to the relevant definition, function and expectations of the street as the bedrock of further study.

2.2.6.2. **The Street: definitions, descriptions and expectations**

Classifications, descriptions and the expectations of the street depend on the definition of the actual word 'street', since this concept is given different meanings depending upon its historical, structural and functional significance. This definition is crucial to distinguish the 'street' from the 'road' or 'thoroughfare' and the same in terms of formal and functional expectations. Moughtin (2003) defines 'street' as an urban artery being wider than an alley or lane but narrower than an avenue or boulevard. He distinguishes between 'road' and 'street' and says:

"[The] road is at once an act of riding on horseback and an ordinary line of communication between different places, used by horses, travellers on foot or vehicles. Or it is any path, way or course to some end or journey. The emphasis is on movement between places, the principle lines of communication between places … a two-dimensional ribbon, running on the surface of the landscape, carried over it by bridge or beneath by tunnel. Street may have these attributes, but its more common meaning is a road in a town or village, comparatively wide as opposed to a lane or alley. More importantly it is a road, that is the linear surface along which movement occurs between the adjacent houses … 'it runs between two lines of houses or shops,' says a dictionary definition. For the purpose of this analysis the street will be taken as an enclosed, three-dimensional space between two lines of adjacent buildings. One particular feature of the road or the thoroughfare which is incompatible with the street is the movement of fast-moving or heavy traffic with all its engineering requirements" (Moughtin, 2003, p129).

In his description Moughtin emphasised on the few factors expected from a 'street'. The first factor is the enclosure of the street, which highlights the importance of the relationship of the street and its frontage. Marcus et al. (1998) also emphasised on the street enclosure as an important attribute, which makes the potential for creating spaces available for public use and enjoyment in the same manner as the various types of plazas. They continue that the pedestrian malls and pedestrian-friendly streets do not succeed merely by blocking the vehicular movement, but they can achieve a plaza-like quality through careful design, enclosure, active frontage and strong variable retail activities (Marcus, Francis & Russell, 1998). The second factor, underlined by Moughtin, is the level of movement in the street. He continued that although both road and street have to facilitate the movement, it is not the only or the most important function of the street. The third factor is the three-dimensional attribute of the street. In his point of view, it is important to design a streetscape and built environment in a way to emphasise this attribute of the street and present it as a three-dimensional element in an urban context, versus a two-dimensional attribute of road and highways.

Rob Krier has highlighted the role of the street, squares and other public open spaces as the 'essential' elements of urban spaces which forms a city. He also describes the street as an urban enclosure primarily for the use of pedestrians, which can create an aesthetically satisfactory environment (Krier, 1979).

Jane Jacobs describes the street that: 'Streets and their sidewalks, the main public places of a city, are its most vital organs. Think of a city and what comes to mind? It is streets. If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull' (Jacobs, 2000, p2). Despite the Krier, Moughtin, Le Corbusier and most of the people who described

the street as an urban planner by emphasising on the built environment, Jacobs criticised the city from a sociological point of view and emphasised on the social life of the street. She criticised car-orientated urban planning as the reason for the disappearing street life. In her point of view all the efforts in designing the physical aspect of the street could only enhance the city, if they support and encourage the social life.

In addition to Jacobs, Moughtin and Jan Gehl also emphasised on the street life, as a priority to serve pedestrians. Moughtin considered the street not only as a physical element in the city but also as a social aspect which can facilitate the movement of people and goods as well as communication and casual interaction, including recreation, conversation and entertainment (Moughtin, 2003). Jan Gehl classified the street activities and highlighted the effect of built environment on them and pointed out the design issues, which can encourage or discourage the street activities (Gehl, 2006).

Lillebye (2001) described the street as 'the pulse of the city' which has an important role as a commercial and social arena. He claims that the life of the cities depends on the sustainable streets and the variety of activities they offer to public. Allen Jacobs (2008) described the expectations of the street as a place for walking, physical comfort, qualities that engage the eyes, a place that in addition to providing an access should bring people together, build a community, cause people to act and interact, and encourage socialisation and participation of people in the community. Additionally it should be physically safe, accessible, joyful and comfortable, which can create a positive impression and catch the eyes and imagination.

All the mentioned definitions and descriptions share some factors, which seem to be important in developing a street. They all consider the street as an accessible place with a good physical condition and maintenance, which supports the socio-economic life of the city. They all also emphasised the importance of pedestrian flow, casual interaction, walk-ability and the street life in general. Considering these points of view, movement and transportation is not the main function of the street but just a part of its numerous functions. In the following part the importance of street network development, considering the mentioned attributes and expectations, in Tehran's regeneration plan are discussed.

2.2.6.3. **Why the 'street' matters in regeneration plans in Tehran**

In the literature of TCRO, multidimensional problems of the deteriorating area in Tehran are highlighted. On the one hand, these neighbourhoods lack accessibility and socio-economic problems, and on the other hand Tehran's Municipality is interested in developing movement and transportation, in all forms of pedestrian, private and public transportation, as the first priority in regeneration (Bertaud, 2003). The fact that 20% to 30% of residential neighbourhoods are usually occupied by the street network (Girling, Kellett, 2005) as well as the fact that in Tehran the street network has occupied the most urban lands after the residential blocks (Naghsh Jahan Pars Co., 2007), this highlights the importance of street network development in Tehran's regeneration plan. The challenge of regeneration plans for the Municipality is the superimposition of wider streets on the present fabric with the purpose of providing better accessibility for all districts to ease the existing ever-growing car traffic (Azimi, 2004). Investing in street network development can be highlighted further by considering its role in forming the urban structure. Christopher Alexander believes that thoroughfares, accesses and the street network are the main components of the city structure. Edmund Bacon also believes that with a well-planned street network, it would be possible to create unity and legibility in the whole urban system. In his opinion the street network is the main element of city structure (Bazregar, 1997).

The problems appear when the street network development is replaced by roads, thoroughfares or highway network expansion, as the result of over-emphasising on car-orientated transportation, especially in attention to the benefits that could be derived from developing public open spaces including the streets. The attributes of the 'street' mentioned in the above section indicate that by identifying Tehran's potential for developing the street network – considering the actual definition, descriptions and expectations – it is possible to get the best results from the least amount of investment. Not only it can enhance accessibility and facilitate movement and improve the neighbourhoods spatially, it can also bring people together, build a community, increase people interaction, improve the socio-economic aspect of the neighbourhood, and finally release the deteriorating areas from isolation.

The potential for streets and sidewalk to create opportunities for public contacts can play a significant role in enhancing social problems such as radical segregation. Cities are full of people with whom a certain degree of contact can be useful or enjoyable. This is the contact

that can happen in the streets as the main public space in the city. The point of the social life of the street and the city sidewalks is that they can bring together people who don't know each other, which is precisely why they are 'public' (Jacobs, 2000). Rogers (2005) also emphasised on the role of street network development in addressing the economic and social disparity as well as the physical manifestations of urban decline. He emphasised on the re-establishment of the street with continuous active frontage and overlooked from upper storeys as well as the presence of passers-by and informal surveillance as an 'urban focus' that shapes people's immediate everyday space. Developing a well-connected street network with the existing urban patterns is highlighted as the main approach in creating or renewing a compact neighbourhood, which is diverse in use and population (Girling, Kellett, 2005, Rogers, 2005, Congress for the New Urbanism, 2007).

The literature on the descriptions and expectations of the 'street' supports the research assumption of the necessity of developing the street network as a type of public open space, which can deliver socio-economic benefits for the Tehran urban regeneration plans. The challenges of this idea are methodological, including how we can develop a street as a social arena; how we can develop an 'accessible' street; and how we can develop a walkable and pedestrian-friendly street in the current urban fabric in the city of Tehran. The key point in addressing these challenges is people's lifestyles in Tehran. In the following parts, the principles that can be applied in addressing the challenges are discussed. Furthermore it is the potential of the city of Tehran, as well as people's desire to 'localise' these principles in order to contribute to Tehran's regeneration plans, that are identified.

2.2.6.4. **The sociable street**

City streets and the sidewalks are bound up with circulation but are not identical with it, although their basic duty is circulation, i.e. carrying vehicles and passengers, and they serve many other outdoor activities and purposes as the main public spaces of a city and its vital organs (Jacobs, 2000). Outdoor activities are numerous and complex though Jan Gehl has classified them in three categories of 'necessary activities', 'optional activities', and 'resultant/social activities' which should be supported by a well-designed street (Gehl, 2006). He describes necessary activities as the ones that are more or less compulsory, such as going to school or waiting for the bus; the activities in which those involved are required to participate. He describes optional activities as the ones that the people involve if there is a

wish to do so and if the time and the place make it possible to do. He considered resultant or social activities as the ones that depend on the presence of others in public spaces. He believes that social activities will appear when the other two types of activities are well supported by the built environment since the social activities usually come after them. He continues that the life between buildings is not merely one of them, but it is a mixture of them, which makes it attractive. Indeed the social activities and people interaction have a wide range of passive or active activities shown in Figure 2-9 (Gehl, 2006). Figure 2-8 and Figure 2-9 show the graphic representation of the relationship between the quality of built environment and the rate of occurrence of outdoor activities (Gehl, 2006).

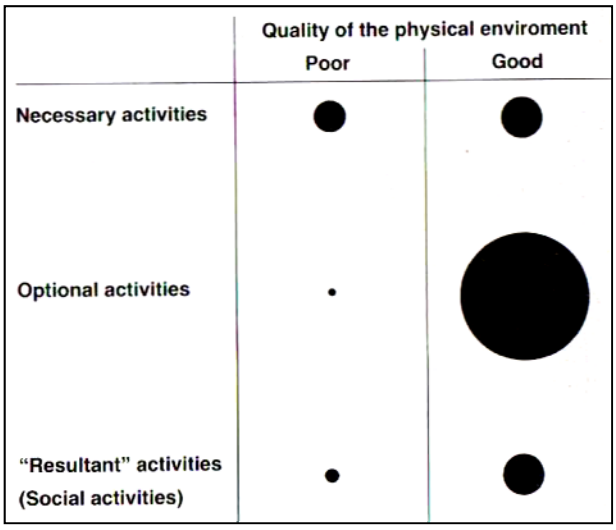

Figure 2-8: the relationship between the quality of built environment and the rate of occurrence of outdoor activities, (Gehl, 2006)

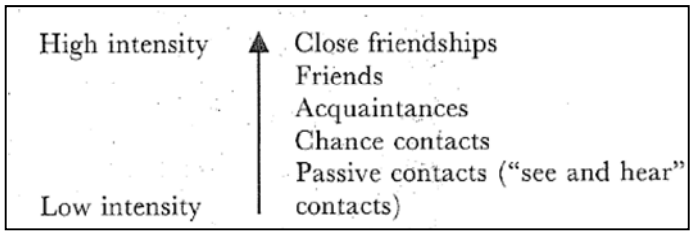

Figure 2-9: The concept of varying degrees of contact intensity, (Gehl, 2006)

The important issue in the street life and outdoor activities is that a low level of outdoor activities tends to make the community more isolated. However, a high level of outdoor activities, in all forms of contact, creates opportunities for people to interact. Even though individuals are not in direct contact with each other, they are not alone either. Outdoor activities are important in increasing people's awareness of their social environment (Gehl,

2006). The process by which the street life in different levels can appear starts with a modest level of contact, and by a possible starting point it can be developed in the future to other levels of contacts. Maintaining already established contacts is an important factor in enriching the process of the street life, which can increase the level of intensity in social relations (Gehl, 2006). In this process, low intensity activities, known as the source of inspiration and stimulation, become important as stimulating activities that can grow to or create activities in higher intensities. A good example of it is when children meet each other in the neighbourhood and start playing. It is the low intensity contact that grows to a group of children and can be maintained in future. The important factor here is that the more possibility people have to access these contacts, the more possibility to make contacts in other forms.

2.2.6.5. **The stimulant factors of social activities**

Gehl (2006) says that people and their activities are the main factor for attracting other people. Children, no matter if they have a front yard in their house or not, tend to play in the busy streets and squares of the neighbourhood. The new activities often start in the vicinity of the current ones since people are usually attracted to the activities happening in the place. The activities tend to grow from the edges, in the case of street frontages, to the middle of the space. Pedestrians are interested to see and be seen, to hear and be heard, and to meet other people, either actively or passively. These opportunities can be provoked more in a crowded place. The research shows that pedestrians are more interested in involving themselves in activities which other people are involved in too. They tend to spend more time in front of shops that have a direct relationship with other people rather than shops, exhibitions, offices and other land uses that do not have the same level of relationship (Gehl, 2006).

Simply, the street that can attract more people can create more opportunities for social life too. In this regard, accessibility of the street becomes important. Hillier (1993) believes that accessibility and spatial configuration play significant roles in making a sociable street. In his theory, 'Natural Movement', he has highlighted that the street which is spatially integrated with the surrounding fabric tends to have a higher level of pedestrian movement which attracts retail business to benefit from the presence of pedestrians. These retailers then become attractors for attracting more people (Hillier et al., 1993).

In order to have community activities and people interaction there should be some prerequisites such as common social/income background, interest, culture, problems, leisure, and concerns. Having these prerequisites is essential to help trigger social interactions and community relationships, which are across physical boundaries, although they can be supported by a built environment (Gehl, 2006). In fact another stimulant factor which can provoke the prerequisites and outdoor activities in the street is the quality of outdoor spaces (Gehl, 2006). The important issue in the relationship between the social and physical structure is that the former is a process which takes time to be created, and the latter is a project which can be done within a certain amount of time. The physical structure and built environment can only facilitate the community activities if they consider the social structure to include a sense of belonging, a degree of privacy and territories, and a gentle transition between them (Gehl, 2006). In this regard two factors should be taken into consideration; the number of activities, and the length of time they take place outdoors. A more physical environment supports these two factors and facilitates their increase, making the street more sociable (Gehl, 2006).

The quality of outdoor space is the result of both the planning system, in a holistic approach, and the design system, in a more detailed approach, including legislation and regulations. In the planning system, the cities with dispersed high-rise buildings surrounded by empty green spaces tend to have a poor social life whereas the compact cities with attached buildings tend to have a better street life (Rogers, 2005, Gehl, 2006). Gehl (2006) emphasises on assembling and integrating people and events in the planning level. He continues that where the land uses, activities, events and peoples are dispersed the environment encourages segregation by all means. However, where the planning regime integrates activities and events, people find more opportunity for interacting, which encourages social interaction in the community. He even advocates integrating pedestrian traffic and vehicular traffic in the residential areas where the speed does not matter [Figure 2-10].

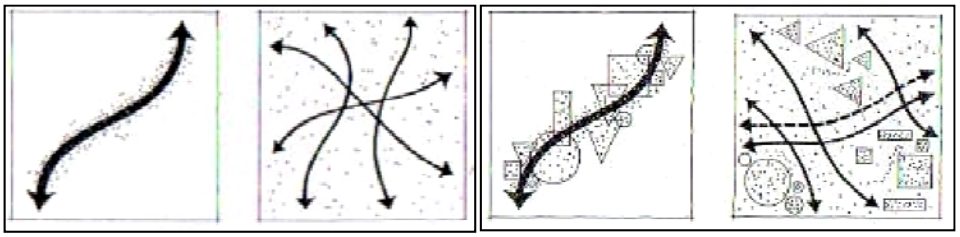

Figure 2-10: (Left) to assemble or disperse; (Right) to integrate or segregate, (Gehl, 2006)

In the design system, there is a positive correlation between the quality of the built environment and the level of the social life, whereby enhancement of the quality of the built environment can increase the level of social life and vice versa. The number of pedestrians in the streets and squares of Copenhagen have tripled between 1969 and 1989 as a result of making pedestrian routes and enhancing the built environment (Gehl, 2006). The same result is found in Melbourne between 1994 and 2004 in which by enhancing the quality of built environment, the number and quality of outdoor activities such as the number of sidewalk cafés and restaurants, city centre residents, retailers, pedestrians and cyclists have increased considerably (Adams et al., 2004). Conversely, the level and the quality of outdoor activities in deteriorating areas with poor conditions of built environment tend to be low since the built environment does not support human activities such as pedestrian safety (Gehl, 2006).

Other factors that affect the level of social interaction are safety and the relationship between people and each other, and the relationship between pedestrians and vehicles. In both, the role of sidewalks becomes important in this regard. When people talk about a 'dangerous' city, they primarily mean that they don't feel safe on the sidewalks of the city. Sidewalks, including their boundaries and the users, are active participants of the modern cities and if a city has a safe system of sidewalks, it is safe. A neighbourhood with safe public spaces is full of strangers – even the neighbours are strangers to each other – but in a successful street the individuals feel safe among all other strangers, the attribute which is the bedrock of a successful public place (Jacobs, 2000). Jacobs pointed out three crucial factors which are necessary for every safe and successful street including clear separation between public and private spaces; public surveillance by having eyes on the street; and continuous pedestrian flow which could make the street lively and secure. No planner can force people to have an eye on the street, but the street which belongs to everyone, both residents and stranger, can invite many peaceful and well-meaning strangers whose existence ensures the surveillance to the public space (Jacobs, 2000). An active frontage with retailers, stores and other public places sprinkled along the sidewalk can make the street sociable and increase the safety of it considerably (Rogers, 2005, Jacobs, 2000, Adams et al., 2004). They make a concrete reason for both strangers and residents to be in the street and use it; they attract people to the street and the sidewalks and increase the eyes upon the street and bring safety to the place; and finally the stockholders are great street watchers who can considerably help to keep order in the area and increase the safety of it (Jacobs, 2000). In Melbourne, retail management had a

great effect on the street life. Throughout one decade, 1994–2004, the dull facades of big stores have been replaced with many retailers in a way that the store plots were deep with a limited length of facade. This policy changed the characteristics of the dull streets to lively streets with an active frontage and variety of services which attract different people with different taste and increased the number of the stockholders who make a community in the street (Adams et al., 2004).

In terms of the relationship between the pedestrians and vehicles, the streets that support slow and fluent traffic tend to have more opportunities for community activities and social interactions, in the other words 'slow traffic means lively city' (Gehl, 2006). The local streets should be considered as a social place in which the ways that both the pedestrian spaces and the carriageway are designed so that the impact of vehicular traffic is minimised. For instance, slowing traffic down and improving the design of the street as a place rather than a transport corridor at the same time can be done by minimising the negative visual impacts of street furniture, e.g. simplifying signing and road markings, or widening the sidewalks, developing the kerb ramps and other safety elements, using trees and organising the side parks (Rogers, 2005). Lighting is an important factor in fulfilling the safety of the streets to make them a 24-hour place of use. The street lighting, beside other factors such as retailers, can draw people and strangers to the main local streets and induce them to contribute their own eyes to the safety of the street (Jacobs, 2000).

Another factor that makes a street lively and sociable are the stationary places which make opportunities for people to stay and linger in the place, to see and be seen, to hear and be heard; a lively street has both users and pure watchers. Streets are not just corridors for transportation. People like to watch other people's activities, which are the main attractions of the street; physical appearance of the street is rarely the focal point of attraction, but it can facilitate the street life (Jacobs, 2000). They make opportunities for public contact, whereby most of it is trivial, but the sum of such casual public contact at a local level is not. The result of this trivial public contact is the feeling for public identity, respect, and trust, and a place where there is an absence of this is an isolated community. The strength of the public contact is not a matter of aesthetic quality or of a mystical emotional effect on an architectural scale, it is the matter of people's lifestyles and the way people use the streets and sidewalks in

practical everyday life. Formal public contact in cities needs a level of informal and casual life underlying them, mediating between them and the privacy of the people (Jacobs, 2000).

'Social norms' also have been highlighted as one of the effective factors in people's activities, especially vulnerable people, in public open spaces (Mohammadi, 2009). A relevant example of it can be seen in a study on the relation between social norms, e.g. being single or married, and women's activities in public open spaces in Iran. This research implies that single girls' social activities in public open spaces have a different relation with the presence of men or families in the space. It also suggests that having children in Iran has a positive relation with women's social activities in the public open spaces. In this regard, single girls tend to have less social activities and more necessary activities in public open spaces. In fact, it proposes that having child-friendly open spaces has a positive relation on women's necessary as well as optional activities in a public open space, and women in neighbourhoods that are not child-friendly have less necessary and optional activities in public open spaces. It also shows that leisure times have a positive relation on men's social and necessary activities in public open space, but it has only a positive relation on women's necessary activities and not on their social activities. This research also suggests that gender separation in a space has a negative relation with men's optional activities in public open space while it has a positive effect on women's optional activities (Mohammadi, 2009).

2.2.6.6. **The potentials of the streets in Tehran**

Consideration of traditional urban planning systems for developing any strategy is one of the purposes of this research. In regard to the streets, the Persian bazaar is taken into consideration. The bazaar, regardless of its marvellous architecture, is a combination of streets, friendly to the mode of transportation of the time and people's activities. The bazaar plays a great role in shaping people's mental image of the city by linking the individual buildings and urban spaces and creating unity in the entire city (Browne, 1976). The linear form of the bazaar makes a unique public and socio-cultural urban space organising other activities in all over the city. Its linearity allows the bazaar to permeate into the neighbourhoods and makes them the centre of socio-economic activities, integrating them with the city (Masoudi Nejad, 2005). Consideration of urban planning tradition is not just about following the forms of urban elements, but is about identifying the characteristics of them and the patterns of their structure and use (Ardalan, 1980). It is the continuity of the movement,

land uses and activities that unifies the bazaar space (Browne, 1976). The bazaar is the main place that people gather in cities of Iran even today, and it also benefits from having the most important city functions in its vicinity (Ardalan, 1980). Having the bazaar as the main public space in Iranian cities indicates that despite many European cities, in which stationary activities are the main activities in the public spaces such as the plaza, movement is the main activity in the Persian's public places and can be considered culturally as a form of leisure.

Karimi (1997) in a study on the spatial structure of some cities in Iran, found that the bazaar is the most integrated street of the city and its branches into the neighbourhoods also are the most integrated routes in the whole area, which creates an integrated system of public spaces in the entire city. Masoudi Nejad (2005) dichotomises the bazaar as commercial and socio-commercial, distinguishing the two by their functions. The commercial bazaar is the bazaar which is constituted of clusters of retailers without playing a great role in social activities, and the socio-commercial bazaar is not only constituted of clusters of retailers, but benefits from having the main urban functions such as the Friday Mosque next to itself and creates a public place for social activities as well as the commercial ones. He highlights that the location of the bazaar in the whole spatial structure of the city dictates the opportunities for having a commercial or socio-commercial bazaar in a city. He develops Karimi's work that the socio-commercial bazaars are the ones that are the most integrated streets of the city or the neighbourhoods. However, the commercial bazaars are not necessarily the most integrated streets. He continues that in the cities with commercial bazaars, the most integrated area of the city and the place of gathering, is somewhere between the bazaar and the Friday Mosque.

Although the bazaar could not develop as fast as the city in modern times, the streets followed its pattern meaning that in present-day cities of Iran the streets are the location of clusters of retailers, usually from one type, which in many cases the social interactions are embedded there as well (Hamidi, Sabri & Salimi, 1997). It seems that the streets in Tehran play the role of public spaces for socio-economic activities if their potentials are well identified. In order to develop such a system we can learn from the pattern of the bazaar in developing a network of integrated accessible streets with socio-economic potentials to create integrated public spaces and link each neighbourhood, including the deteriorating areas, to the entire city.

2.2.7. **Summary and key conclusions: The potential of public open space**

As it is evident in the above sections, public open space developments can deliver socio-economic and environmental benefits, especially if considered as a part of a large integrated system. In order to consider public open space in an integrated system, identifying its elements can facilitate the planning. In this regard, the street network including the greened street, street plaza, pedestrian mall, civilized street and shared-use spaces, can be considered as the predominant connective element in the public open space system, playing the most effective role in delivering the benefits into people's daily lives. The interest of this research is also the street network, since they have occupied more urban spaces in Tehran in comparison to the parks and green space. Moreover, it is also assumed that optimising and enhancing the street networks can deliver considerable benefits to the outdoor public life. The street network development is also the interest of the government, which can increase the feasibility of the implementation of the research as well. A well-developed street network can also release the deteriorating areas from socio-economic and spatial isolation (Rogers, 2005). Rogers (2005) emphasises the street as a place and says that "[....] a*t the top of the road hierarchy, the role and function of major roads must be recognised as changing when they enter urban settlements. While they remain streets based upon ease of traffic movement, these roads should become much more clearly managed, with greater priority given to public transport through dedicated lanes, and speeds should drop to enable appropriate development alongside the highway. Within a short space of having entered the urban settlement, the road should form part of the overall fabric of the town or city*" (Rogers, 2005, p57).

2.3. **Natural movement theory**

The theory of natural movement was developed by Hillier and Hanson (1984) and investigates the relationship between social and spatial forms. Hillier believes that space is a key aspect of how social and cultural worlds are made in the real world. However, since space is built into social and cultural life, it is usually taken for granted to the extent where its forms become invisible (Makrí, Folkesson, 2000). Hillier (2007) claims that social and spatial forms follow such a consistent pattern that spatial configuration determines social patterns such as land use and movement. He argues that, over time, a dynamic relationship develops between the

evolving urban spaces and the pattern of movement, as well as the pattern of land use distribution.

2.3.1. **Definition and description of natural movement theory**

Natural movement is defined as the movement generated by a grid configuration (Hillier et al., 1993). Natural movement theory believes that, in order to have sufficient and well-used urban spaces, the local properties of the space – e.g. form, size, and physical components – are not as important as its configuration in relation to the larger urban system (Hillier et al., 1993). A key outcome in this theory is the concept of 'spatial configuration' meaning relations that take account of other relations in a constellation (Hillier, 2007). In this regard, the most important element in analysing space and people's activities within it is to consider them as a configuration. In fact, it can be said that the relationship between space and social patterns, such as the pattern of distribution of commercial land use, does not lie merely at the level of the individual space, but in the relationship between configurations of people and space (Hillier, 2007).

In regard to the study of the relation between the space, people's activities in it and the social aspects, Hillier and Vaughan (2007) place a particular emphasis on the concept of 'the city as one thing'. They say that the city is usually considered as two things, including a large collection of buildings linked by space simply called the 'physical city', and a complex system of human activity linked by interaction, known as the 'social city'. In this regard, urban practices and research usually utilise the morphological disciplines for studying the physical city on one side and the social sciences for studying the social city on the other which necessitates a hierarchising of one city above another. The authors continue to add that there is a bipolar relation between the 'social city' and the 'physical city', and in fact the 'social city' is on either side of the 'physical city'. In the first step, the social city brings the physical city into existence and then acts within the imposed constraints (Hillier, Vaughan, 2007). In practice, we can also find the city as one thing at any given time. In this regard, we can refer to the fact that, usually, small-scale, inward-looking residential developments promote community or mixed land uses, reducing crime. Furthermore, notions of segregation in urban studies (the stated focus of this research) support the idea of the city as one thing. It is easy to formulate ideas about segregation purely in terms of social and economic factors without invoking space. However, segregation is a spatial term and a phenomenon. In a condition

where there are patterns of segregation clusters in a city, one question will be highlighted, whether the urban segregation has a significant physical meaning over and above its social meaning (Hillier, Vaughan, 2007).

In addressing the one city question, Hillier adds to the existing multiplicity of spatial concepts, a new idea known as 'spatial configuration'. The idea is that by learning to describe and analyse different kinds of spatial configuration, or patterns in the city, it would be possible to detect the influence of social factors on construction of the spatial patterns, as well as the consequences there might be in terms of how social life could and did take place (Hillier, Vaughan, 2007).

In order to understand how a configuration of space can influence or be influenced by a configuration of people, Hillier illustrates an example shown in Figure 2-11. Here, three courtyard buildings are shown which share similar patterns of physical elements, adjacencies between components and the number of internal and external openings. All that differs is the location of cell entrances which do not affect the buildings structurally, climatically or physically. However, this is enough to perceive how each space can be experienced in relation to the others, or how people can perceive the space and the spatial pattern in each building and understand how this differs from the others. The space pattern, shown in a graph for each building, suggests that the differences of the three buildings are inherent in the space patterns, and could apply to whole classes of human activities. This example simply shows that in terms of the relation between space and activity, it is evident that it is the spatial configuration which affects people's experience of the space and the pattern of their activities, interaction and so on. This is before any attributes of the space, such as its shape, material, size or anything else, is considered. With further analysis, by working on these pattern properties in a numerical way, clear relations between the space patterns and how people use them become identifiable (Hillier, 2007). A numerical approach can help us to quantify the qualitative aspect in urban studies.

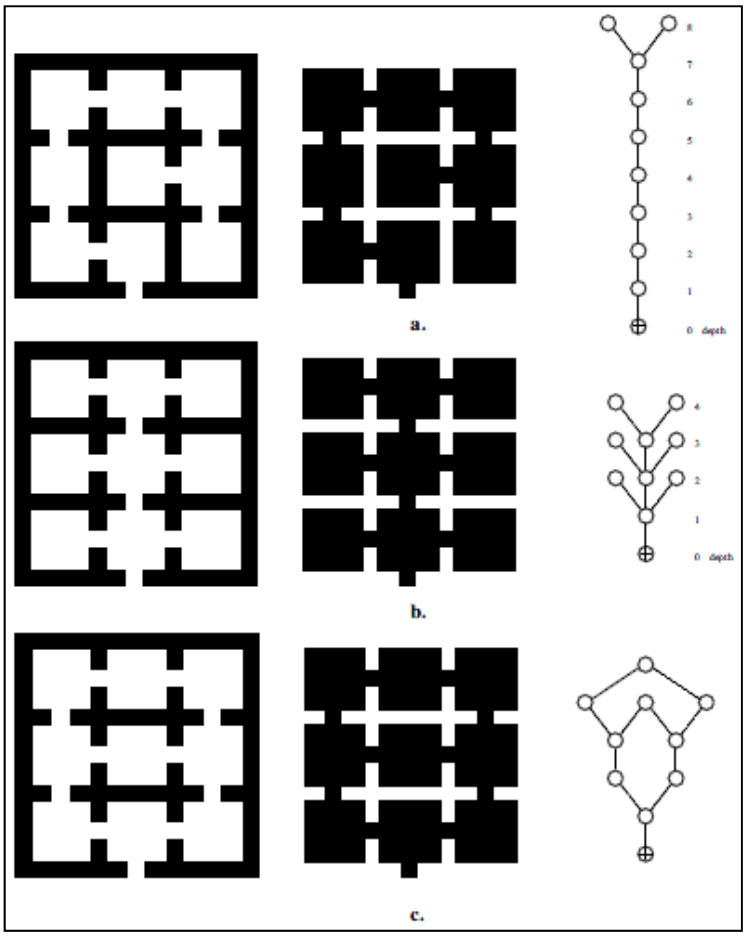

Figure 2-11: An example for understanding a configuration of space, (Hillier, 2007)

Hillier's argument is based on two formal ideas, which take into account both the objectivity of space and people's intuitive engagement with it. The first idea is not to consider space as the background to human activity, but as an essential aspect of it. For instance each activity of moving, interacting and making visual contact needs a necessary spatial geometry; people move in line, interact in convex spaces and see changing visual fields as they move around the built environment [Figure 2-12]. Each of these geometric ideas describes how we use or experience space (Hillier, Vaughan, 2007).

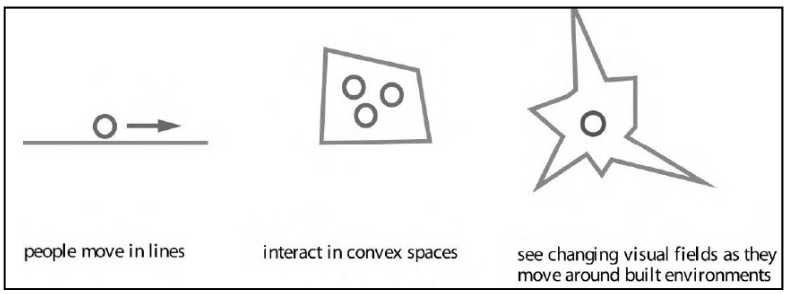

Figure 2-12: Space is not a background to activity but an intrinsic aspect of it, (Hillier, Vaughan, 2007)

The second idea is that the properties of individual spaces in shaping human space are not as important as the interrelations between the many spaces that make up the spatial layout of the built environment. This interrelation is formally called configuration as described above (Hillier, Vaughan, 2007). The importance of investing in this idea of spatial configuration and the application of this theory in the case of this research is discussed below.

2.3.2. **Why to apply natural movement theory in this research**

The focus of this research is on integrating the deteriorating area into the surrounding urban fabric in order to increase the pedestrian visits from these areas, as well as making opportunities for the creation of socio-economic stimulant zones using the street network development. In this regard, the relation between the spatial pattern of deteriorating areas and the pedestrian movement pattern, as well as its relation to the pattern of land use distribution, becomes highlighted. In terms of the application of the theory of natural movement in achieving this purpose, the key suggestion is that the configuration of the urban spaces itself is the main generator of the movement patterns (Hillier et al., 1993). It also highlights the role of spatial configuration and the structure of the urban grid in the distribution of land use and 'attractions' as a result of directed 'to-movement' and 'through-movement' the spaces in the city (Hillier, 2007).

This theory introduces 'natural movement' as the movement generated by the grid configuration, which is not necessarily the largest component of movement in urban spaces, but the most predominant type, so that without it most spaces will be empty for the majority of the time. The attractions are then located to take advantage of the opportunities offered by the spatial configuration, and the subsequently generated passing trade and movement may act as further multipliers. It does not mean that the greater proportion of movement is generated in all situations by the configuration, but it is important to consider the spatial configuration as the primary generator, without which we cannot understand the pattern of pedestrian movement or the distribution of attractors (Hillier et al., 1993). In terms of the probable effects that spatial configuration, attractions and movement can have on each other, this theory proposes that while configuration can affect both movement and attractions it cannot be affected by these two [Figure 2-13] (Hillier et al., 1993).

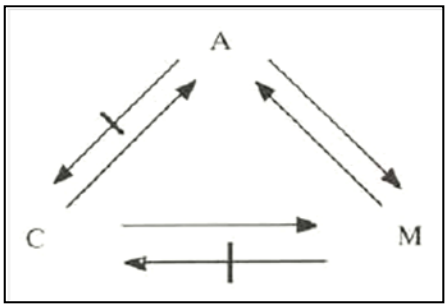

Figure 2-13: 'A' is attraction, 'C' is configuration, and 'M' is movement (Hillier et al., 1993).

This theory believes that movement is fundamentally a morphological issue in urbanism. It is a functional product of the intrinsic nature of the grid, and not a specialised aspect of it. In fact, spatial configuration is potentially a predictor of both pedestrian and vehicular traffic flow in urban environments (Toker, Baran & Mull, 2005). Thus, in order to investigate movement and space use in general, the question of urban form itself needs to be considered (Hillier et al., 1993).

2.3.3. **Space syntax and natural movement theory**

An advantage of natural movement theory is not only that it offers a theoretical approach in urban studies, but it also delivers an analytical technique and tool for future analysis called 'space syntax'. "...space syntax is a set of computer techniques for modelling buildings and cities in which spatial layout is first represented as systems of linked geometrical elements-lines when studying movement convex elements when studying interaction, fields of view when examining more complex patterns of behaviour – and then analysed in terms of the relations between each spatial element and all the other spatial elements in the layout" (Hillier, 2004, p46). It is important to understand that space syntax is not just a modelling technique for movement, but also for comprehending the complexity and the logic of the morphology of urban grids, and their growth (Hillier et al., 1993). It is a method to understand the spatial configuration or pattern of inhabited spaces in such a way that their underlying social logic can be recognized as well (Hillier, Vaughan, 2007).

In practice, space syntax is used to evaluate how alternative design options meet precise design objectives, or help to generate design alternatives that address a specific problem. Space syntax can also be applied where researchers need to describe how spatial environments enable or impede users' behaviours, such as movement. It can be used where

we need to study a pattern of social activity in the city, such as the pattern of pedestrian movement or land use distribution. Space syntax provides a unique foundation for evidence-based learning as well as a systematic framework for comparing environments and their performance (Peponis, Bafna & Shpuza, 2004).

Space syntax has also the potential to investigate the issue of accessibility in analysing street networks and pedestrian movement, which is also within the scope of this research. Accessibility is usually divided into parts including geographic and geometric accessibility. Geographic accessibility investigates individual accessibility using GIS network analysis, which is based on 'node-link' representation of transportation networks and metric distance measurements. However, geometric accessibility investigates place accessibility such as the accessibility of streets using space syntax based on network configurations (Jiang, Claramunt & Batty, 1999, Abubakar, Aina, 2006).

In order to explore this issue, we must establish how space syntax works. “Space syntax is about applying configurational measures to the patterns of different geometric elements that are created by buildings and cities. Whether we choose lines, convex spaces, isovists, or even points as the elements for our analysis depends in what aspect of functionality or human spatiality we are investigating” (Hillier, Vaughan, 2007, p4/18). At the next stage space syntax captures the pattern of this configuration in the format of a graph [Figure 2-11] and then “takes certain common measures of relationality in graphs, and first theorises them in terms of their potential to embody or transmit social ideas, and then turns them into measures and representations of spatial structure by linking them to geometric representations of the system of spaces under examination (Hillier and Hanson 1984). These measures are essentially formal interpretations of the notion of spatial integration and segregation, and it was the formalisation of these terms which first seemed to identify structures which linked the social and the spatial. Providing a measurable scale from segregation to integration, enabled statistical comparison of different spatial forms across cultures, and so provide a platform from which social origins and consequences might be investigated” (Hillier, Vaughan, 2007, p2/18).

Syntactic analysis – the task of space syntax – generates several maps and measures, some of which are the interest of this research, including axial line maps and global integration, local integration, connectivity, choice and intelligibility measures. Throughout the literature review on space syntax, the author realised that by applying this method and studying the measures

in this research it could be possible to study the spatial attributes such as spatial configuration and the spatial structure of both the city and the deteriorating areas. Moreover, it would be possible to investigate accessibility and the pattern of street network expansion, pedestrian movement and land use distribution, which are the socio-economic aspects of the city.

2.3.4. **Studying the public open space system using space syntax**

In order to study how open space is constructed, space syntax delivers a method that could be applied in this research as well. Figure 2-14a shows a small town in France in which the ground floor of the buildings are illustrated. In order to capture the idea of 'open space' the public space is shown in black and the floor space of the buildings has been left white [Figure 2-14b]. In order to capture the structure of open space; a 'convex map' is first created using this method dividing the map into several 'convex' spaces in a way that the entire system is covered by the fewest number of the widest convex spaces [Figure 2-14c]. At the next step an 'axial line map' is produced by drawing axial lines, starting by the longest line, which cuts across the convex spaces and covers the whole system [Figure 2-14d] (Hillier, Hanson, 1984).

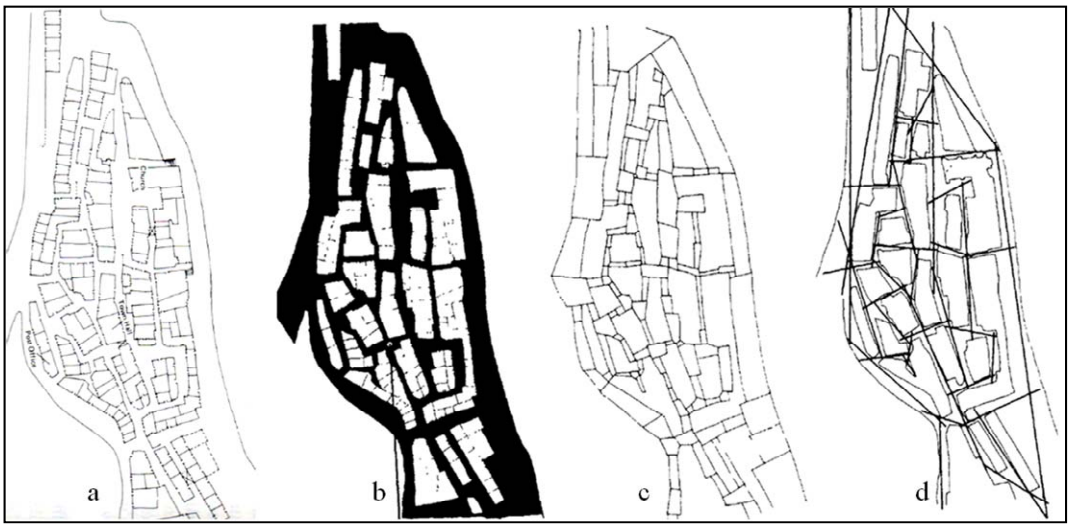

Figure 2-14: The axial representation of open space, (Hillier , Hanson, 1984)

The very basic elements of space syntax, which makes syntactic analysis possible, are these maps including the axial map and the segment map. The axial map represents the continuous lines of movement and sight that covers an entire spatial system (Figueiredo, Amorim, 2005). The axial map consists of the fewest and longest straight lines that can be drawn through the spaces of the grid in such a way that the grid is covered, meaning that all rings of circulation

are completed and all convex elements passed through (Hillier et al., 1993). The axial map and the syntactic measures derived from it have been successful in studying the social and cultural roles of space, mostly for the evaluation of the impact of spatial configuration on pedestrian and vehicular movement patterns. However, there are some limitations in creating the axial map which make for controversial discussions. The most relevant critiques refer to the inadequacy of the axial model in representing curved and sinuous paths. Despite being formed by a sequence of lines of sight, these paths are often recognized as a continuous line of movement. However, the standard axial representation breaks these continuous lines into a set of short sequential axial lines, misrepresenting important inherent global properties of the spatial system. Additionally, axial lines are usually drawn manually and thus, to some extent, are arbitrary as there might be different ways in representing a single curved path. Figure 2-15 shows three different axial representations of the same path (Figueiredo, Amorim, 2005).

Figure 2-15: Three axial representations of the same curved path, (Figueiredo, Amorim, 2005)

Another limitation of the axial map is the generation of long lines. In large and complex urban systems, it is common to find long and straight avenues that extend for several kilometres, crossing large portions of the grid. Consequently, because of their length, these long axial lines tend to be highly connected and integrated. Additionally, these routes are usually lines of movement but are not exactly lines of sight, because no one can ever completely see the whole space in these long and straight streets (Figueiredo, Amorim, 2005). In responding to the first critique, it is important to consider that Hillier has highlighted the notion of the 'fewest lines', which leaves less doubt regarding which one of the options in Figure 2-15 to choose. Moreover, another method for generating the map that has been developed, called the 'segment map', uses road-centre lines extracted from GIS and has a different method of calculating the syntactic measures. The literature also confirms that even this new model is a better empirical model of vehicular movement than earlier axial models (Dalton, Peponis & Dalton, 2003, Turner, 2007a, Turner, 2005, Turner, 2004).

Although applying road-centre lines and producing the segment map can solve the limitations of the axial map, the second critique regarding lines of sight still remains an issue in the segment map as well. In responding to this critique, Hillier suggests that “at the most elementary level, people move in lines, and tend to approximate lines in more complex routes” (Hillier, 1996, p. 153 cited from (Figueiredo, Amorim, 2005)). According to Hillier’s statement, it seems that the notion of ‘lines of movement’ seems to be more relevant to the exploration of the urban grid than the notion of ‘lines of sight’. Also, people in movement may miss details of the space while trying to concentrate on the path and may not perceive slight changes in direction as changes of spatial units (Figueiredo, Amorim, 2005).

2.3.5. **Syntactic measures and spatial attributes**

Space syntax takes the map discussed earlier and converts them into graphs in which each node represents a line, and the connection between each pair of lines is represented by a link between the nodes [Figure 2-11]. It then takes the graph and, using mathematical calculations, produces a number of measures based on the graph, describing the configuration properties of the grid (Hillier et al., 1993). Some of the measures and their attributes are described in this part without digging into the mathematical formulas behind them, since their meaning is more important for this research than the calculation processes.

The first measure is ‘connectivity’, which is the number of nodes directly linked to each individual node in the connectivity graph. It shows how each node links to its immediate neighbours, and how they link to every other node. The ‘control’ value is another measure which shows the degree of choice each node represents for nodes directly linked to it, measuring the degree to which a node ‘controls’ access to and from its neighbours (Hillier et al., 1993, Abubakar, Aina, 2006, Jiang, Claramunt & Klarqvist, 2000). The most known measure in space syntax is ‘integration’. It is related to the depth and mean depth in the graph for each node. It can be computed by calculating the mean depth of each node from all other nodes in the graph (Hillier et al., 1993). “Integration of a node is by definition expressed by a value that indicates the degree to which a node is integrated or segregated from a system as a whole (global integration), or from a partial system consisting of nodes a few steps away (local integration)” (Jiang, Claramunt & Klarqvist, 2000, p164). The most integrated lines are those from which all others are shallowest on average and the most segregated are those from which they are deepest (Hillier et al., 1993). In most cities, integration core maps will pick

out the main streets and shopping areas, whereas the least integrated will tend to pick out areas with primarily residential functions (Hillier et al., 1993).

'Choice' or 'betweenness' is another measure that can be derived from the axial or segment map. It shows the relations between each space and the whole system, indicating how often each line is used on the topologically shortest paths for all pairs of possible origin and destination locations in the system, or how often each line is visited on random journey simulations through the topologically shortest paths in the system (Hillier et al., 1993). Researchers have mentioned that the choice measure seems to be a more intuitive model for movement than the traditional space syntax measure of integration (Turner, 2007a, Hillier, Iida, 2005). Another measure relevant to this research is 'intelligibility'. A city is intelligible if an unfamiliar person wandering randomly in the network of streets has a higher proportion of choice directing them to the most integrated streets or passing through the streets with a high measure of choice. In other words, if in a city the streets with a higher degree of integration connect to more streets on average, and the streets that are globally segregated connect to fewer streets directly, then the city can be said to have a high degree of intelligibility (Bafna, 2003). Intelligibility can also be measured by the correlation between the local and global parameters, which can be defined by the co-efficiency of correlation between local and global parameters. A local area is intelligible if its co-efficiency value is higher than the value for the global area, [Figure 2-16] (Jiang, Claramunt & Klarqvist, 2000).

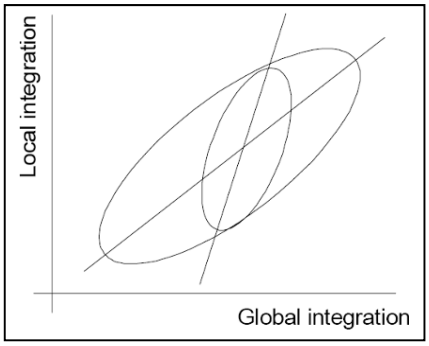

Figure 2-16: Illustration of intelligibility. "The large oval represents the cluster of all spaces of a whole area, while the small oval represents the cluster of a selected local area. Global parameter characterises the global integration, while local measure denotes either the connectivity or local integration." (Jiang, Claramunt & Klarqvist, 2000, p164)

‘Edge effect’ is an attribute that needs to be checked in space syntax carefully. In the axial map, the lines located at the edge of the map tend to become blue representing segregation. The reason for that is because they are simply located at the edge of the map and there is no chance for them to become integrated to the lines in the middle of the map. The ‘edge effect’ needs to be checked in the map, and it is best to eliminate the segregated lines at the edge from analysis to get a better resolution in statistical analysis. In order to do so the map must first be large enough to minimise the likelihood of edge effect and to locate the case study in the middle of the map rather than at the edge of the map (Vaughan, Stutz, 2001, Hillier, 1996). Another method is to use radius–radius analysis, meaning that the integration analysis is set at the mean depth of the whole system from the main integrator. To do this, the global integration needs to be analysed and then the mean depth of the whole system from the most integrated line in the map needs to be calculated. Afterwards, the integration map should be analysed again using the mean depth as the radius. This map is called radius–radius integration. The result of such analysis is that each line is analysed at the same radius, which is at the same time the maximum radius possible without differences in radii between lines. The effect of radius–radius analysis is to maximize the scale of the analysis at a more global scale without having the ‘edge effect’ (Hillier, 1996). Syntactic measures highlight different spatial attributes, applicable for most of the cities around the world. For instance, the axial line map reveals that urban street networks usually consist of a very small number of long lines and a very large number of small lines (Hillier, Vaughan, 2007). Much research into different cities has come to the same conclusion; there is a positive correlation between pedestrian movement and global and local integration (Hillier et al., 1993, Hillier, Vaughan, 2007, Toker, Baran & Mull, 2005, Abubakar, Aina, 2006, Bafna, 2003, Penn, Turner, 2002).

Hillier et al. (2007) have studied spatial configuration and urban structure, revealing that cities are spatially constructed on a pattern of gradations on the scale of integration–segregation. Their studies show that the integration map for cities is almost like a deformed ‘wheel’, in which the most integrated lines are located in or near the geographical centre of the city and some integrated lines extend from the centre to the edge to make a link between the city centre and the suburbs and residential areas. The more obvious and strong the city centre is, e.g. London or Tokyo, the more integrated the central lines are and the more similar to the ‘wheel’ the integration map is. Their studies also revealed that the choice map for the cities usually takes the form of a network. ‘Pervasive centrality’ is another idea that Hillier proposed

by applying space syntax in studying the spatial structure of the cities (Hillier, 2009). He says that *"[.....] cities in general, as we have said, take a generic dual form: that of a foreground network of linked centres at all scales, from a couple of shops and a café at the smallest scale to whole sub-cities at the largest, all set into a background network of mainly residential space [....]. The foreground network is made up of a relatively small number of longer lines, connected at their ends by open angles, and forming a super-ordinate structure within which we find the background network, made up of much larger numbers of shorter lines, which tend to intersect each other and be connected at their ends by near right angles, and form local grid like clusters. Least angle choice measures will normally identify the foreground network [...]*" (Hillier, 2009, p K01:4).

This idea city centres follow a spatial pattern in all scales and no matter where you are, you are close to a small local centre and not far – considering the intelligible distance and not necessary the physical distance – from a much larger one. The idea of having multi-scale centrality criticises the notions of 'polycentric cities'. In fact "multi-scale centrality should be seen as a pervasive function in cities, with clear spatial correlates, and not simply as a hierarchy of locations. What appears to be a multi-scale pattern of linked centres arises in cities through a well-defined process of self-organisation, based on the relationship between the grid structure and movement at all scales" (Hillier, 2009, p K01:6). In identifying the centres at each scale, least angle choice measure at that specific radius could identify a segment with a significantly higher value than others, so it seems likely that these segments may be acted as local 'seeds' for the development of the centre (Hillier, 2009). These 'local seeds' are in fact the 'socio-economic stimulant zones' we are seeking for which could trigger the socio-economic regeneration in the deteriorating areas.

Space syntax is also used in studying the relationship between the social exclusion and spatial isolation in the deteriorated urban areas as well. The main attribute of deteriorated urban areas is 'isolation', however not every isolated area can be classified as a 'deteriorated urban area'. In this regard, residential areas are usually less integrated than commercial areas and are located in the background of the most integrated routes and are relatively segregated (Hillier, Vaughan, 2007). In fact, there is a difference between 'voluntary segregation', in which a group of people with similarities, e.g. wealth, choose to be isolated from others, and

'involuntary segregation', in which a group of people become excluded from the society unwillingly (Vaughan, 2005).

The spatial configuration represents the physical and social processes of the city that have interrelationships with each other. However, when the social process and physical process are no longer interacting, and where there is a raw confrontation between new forms of space and an absent spatial culture within the same context, spatial segregation may cause socio-economic problems (Hillier, Vaughan, 2007). Hillier et al. (2007) illustrated some spatial attributes of this type of segregation by examining a low-rise high-density neighbourhood where they found a dramatic reduction of the axial scale of spaces, a more complex spatial pattern and a lack of internal structure when compared to the surrounding areas. It also showed that these areas are usually integrated at the edges, but segregated in their interior causing a lack of continuity with local areas. Spatial segregation is a problem that can also be seen in self-generated urban areas or immigrant settlements. Self-generated neighbourhoods are usually located near the city centre to benefit from the economic situation there, whereas they are limited economically and socially within themselves (Vaughan, 2005). Vaughan in her study on immigrant quarters in London shows that the neighbourhood of her case study was not only segregated from the surrounding areas, but also the measure of depth – i.e. the number of streets turning away from the quarter to the city centre – was considerably higher, which makes the accessibility of the neighbourhood to the city centre difficult. In her case study the neighbourhood centre was reasonably well connected to the city centre. It suggests that regardless of the vicinity of the neighbourhood to the city centre, the area was segregated socially, while it could survive economically because the main street of the neighbourhood was connected to the city centre. She concluded that the spatial segregation of the neighbourhood encourages poverty, and that planning itself is the main cause of socio-economic problems.

2.3.6. **Main points of applying natural movement theory in this research**

The emphasis of natural movement theory is the spatial configuration and its relation to movement and attractions such as commercial land uses. Considering that the focus of this research is increasing the integration of the deteriorating areas into their surrounding neighbourhoods by developing a sociable street network and attracting people to the deteriorating areas, the application of this theory seems to be useful for this research. The

benefit of applying space syntax and natural movement in this research would be highlighted more by considering the fact that the TCRO is also seeking methods to attract private sector participation to the deteriorating areas and enhance the economic condition of these areas. The application of space syntax and natural movement theory could help this research to come up with a street network that due to its spatial configuration not only could capture the movement pattern in the deteriorating areas, but could also identify the routes with a high commercial potential in order to trigger the socio-economic stimulant activities. However, the approach of this method is very holistic and does not necessarily consider the patter of street life in the deteriorating areas; the gap which could be fulfilled by observational methods.

2.3.7. **Limitations of space syntax in this research**

In addition to the technical and conceptual limitations highlighted in the literature and discussed above [section 2.3.4], this research found some other limitations specific to this work and tried to modify them by applying other methods, mostly observational ones. Although space syntax might be a very strong tool to capture the spatial structure of the city and study the pattern of the socio-economic aspect in a city, it cannot record the level and the quality of social activities and peoples' interactions happening in the streets. In this regard, two observational methods including site observations and behaviour mapping were applied to fill this gap.

2.4. **Summary and key conclusions**

Throughout reviewing the history of urban regeneration in Iran, the researcher found some methodological gaps with regard to the notion of 'isolation' and 'socio-economic stimulant zones'. With respect to this, the researcher has formulated an assumption by emphasising on the role of public open space, pedestrian movement, and people's lives in the deteriorating areas as the key points that need to be considered in the regeneration plans. In this regard, a review on public open spaces was conducted and the concept of the integrated public open space was introduced, then the street networks as the main elements of this system were highlighted. In order to distinguish streets from arteries and thoroughfares, the sociable factors of streets were also highlighted. At the next stage, the theory of natural movement and its benefits for this research were discussed. Spatial configuration of street networks as the

determinants of both movement and commercial land uses were also highlighted. However, considering the limitations of space syntax, observational methods were also applied.

3. Chapter Three: The history of urban regeneration in Tehran

This section discusses a brief introduction to the research context, including the history of Tehran as well as some general attributes of the city. These include spatial organisation, the spatial structure and the population of the city, as well as a few maps from the Tehran Master Plan to give the reader a clear first impression of the context of the study. For this purpose the governmental reports such as the Tehran Master Plan are used to ensure accuracy of the data and statistics.

3.1. Historic development of Tehran over time

Tehran is located on the southern slopes of the Alborz Mountains. In 2002 it had a population of 7.6 million people, and this is still increasing (Bertaud, 2003). The earliest information about Tehran's built environment is given in the thirteenth century by the famous geographer YaqLlt, that it had 12 quarters with underground houses and a ring of gardens. The town must have grown from the south to the north, towards the mountains, and that the oldest parts of the town are in the Ghar quarter in the south of the present-day city. Like other Persian towns, Tehran had a square shape with four gates opened on its four sides (Madanipour, 1998). Tehran was selected to be the capital city of Persia (Iran) in 1785 by Shah Qajar, Agha Mohammad Khan, and since then it has developed from a small village to the present metropolitan city [Figure 3-1] (Madanipour, 1998; Ghafari, Coulabadi, 2006). After becoming the capital city of Iran, Tehran started to flourish. In 1796, the population of the city was approximately 15000 and the city itself was a square of little more than 3 km, of which only a half was built upon. The city of Tehran had an axial layout and functional structure in 1858 [Figure 3-3] (Madanipour, 1998). Throughout the time the population of Tehran grew and the city spread beyond the limits of its physical boundary and in the late 1860s, the extramural inhabitants formed a tenth of its population. The first attempts to transom the old city were made during the long reign of Nasser al-Din Shah (Madanipour, 1998). The dramatic change of the city began at this time. The process of change started from the royal compound, by the reformist vizier Arnir Kabir, by restoring its walls, improving its streets for the movement of vehicles and laying out a new, large square called Tup-Khaneh (Madanipour, 1998). The two

main squares were also improved and beautified [Figure 3-3]. The transformation of the city continued during the Nasser al-Din Shah by developing new buildings in the city including Shams al-Emareh Palace and SepahsaJar mosque. The trend of transformation of the city increased dramatically at the end of Qajar era and the beginning of Pahlavi era in Iran by Reza Shah, the ruler of the time (Madanipour, 1998). At this time the city walls were demolished and the city developed outwards by modern streets and turned it into an open matrix [Figure 3-4] (Madanipour, 1998).

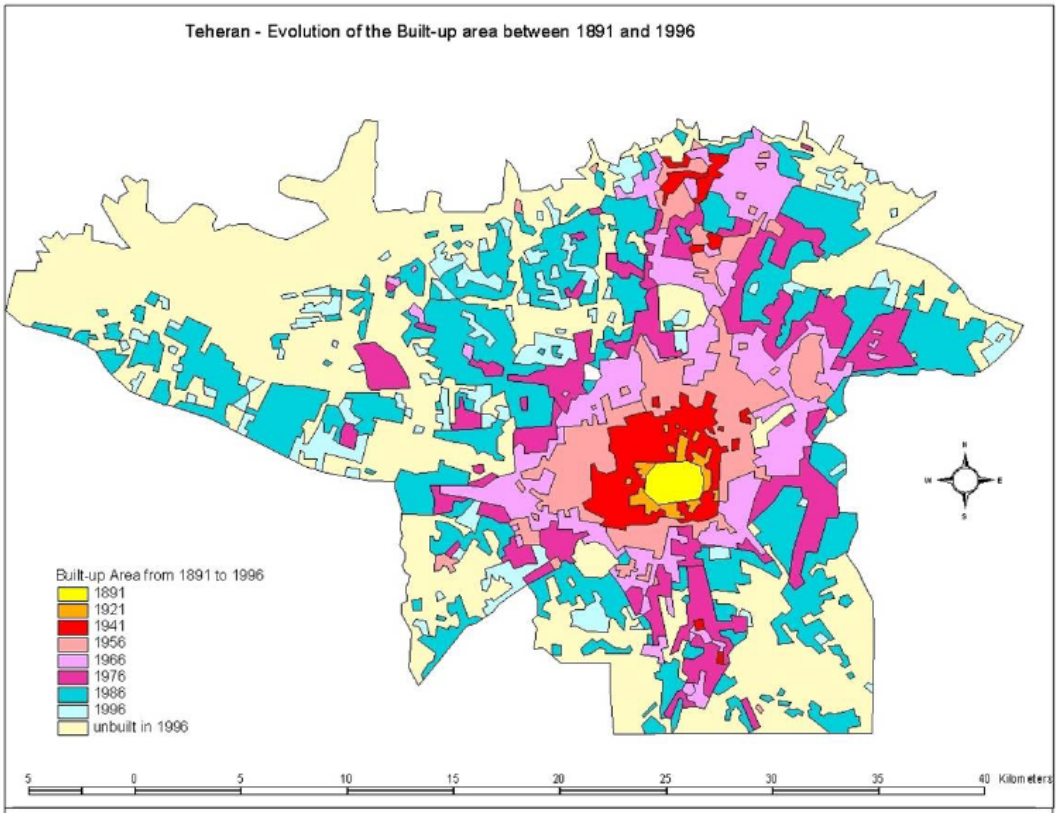

Figure 3-1: Evolution of the Built-Up area between 1891 and 1996 (Bertaud, 2003)

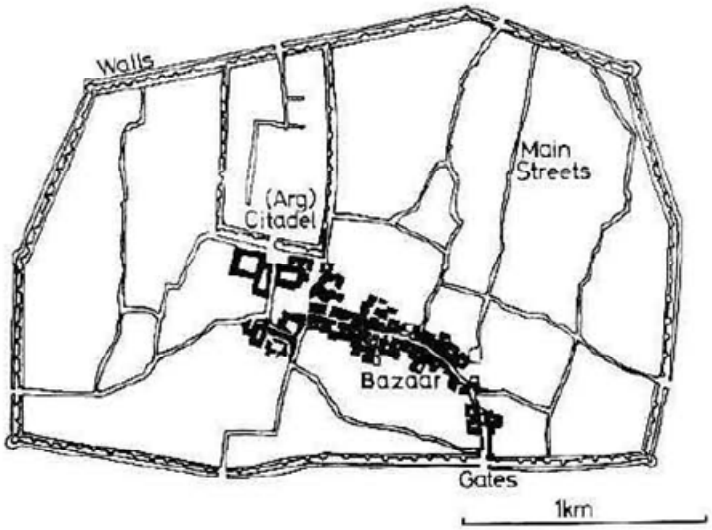

Figure 3-2: Tehran in 1858 (Madanipour, 1998)

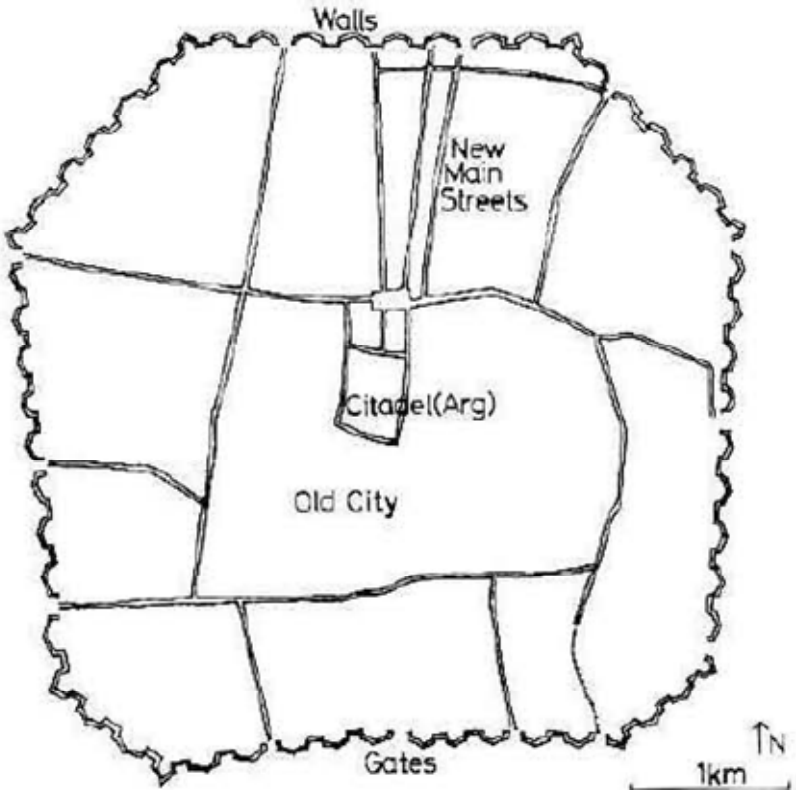

Figure 3-3: Tehran in1890 (Madanipour, 1998)

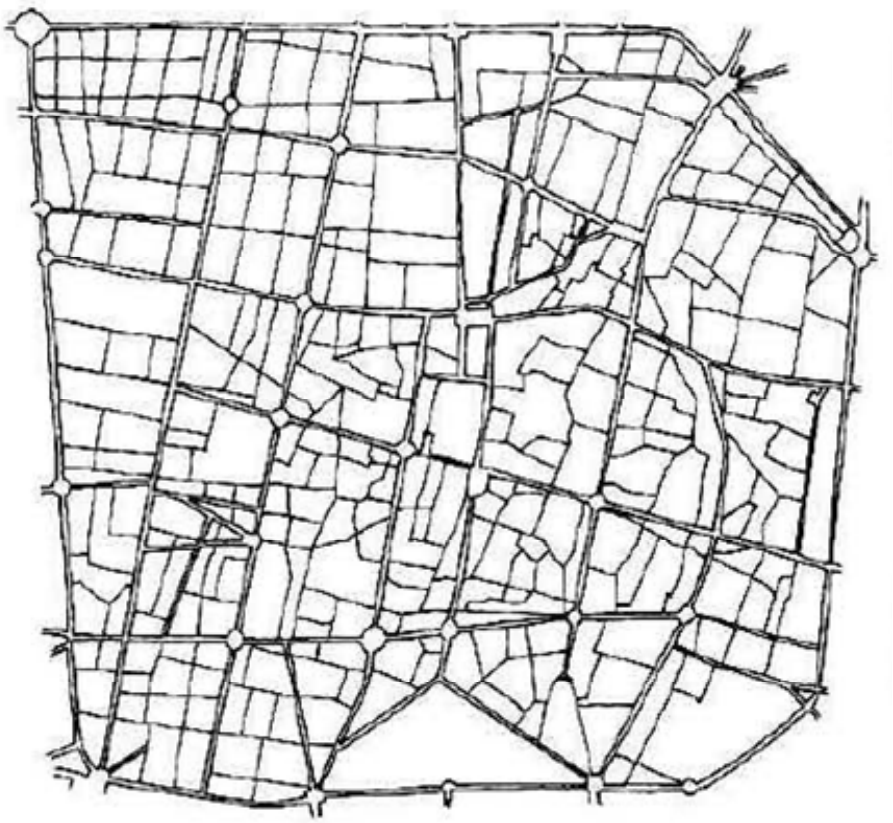

Figure 3-4: Tehran in 1937 (Madanipour, 1998)

3.2. **The modern Tehran:**

In the previous section the historic development of the city was discussed. In this section the current condition of the city are brought. The area of Tehran Municipality is some 700 square kilometres (Bertaud, 2003). Bertaud[8] classified Tehran as a dense 'polycentric' city - as he says - with an average of 146 people per hectare in the built up areas, a high-density by world standards [Figure 3-5]. The population of Tehran is projected to be almost 8.7 million by 2027. The estimated urban territory is 611 square kilometres [Figure 3-6] and the estimated province territory (shown with a blue boundary in Figure 3-7) is 5924 square kilometres as calculated in the Tehran Master Plan (2006) (The Ministry of Housing and Urban Development of Iran, 2007).

8 Alain Bertaud is an urban planner whose interest is in translating the theories and equations of urban economists into approaches and methods and spent some time at Tehran to make a report for the Ministry of Housing and Urban Development.

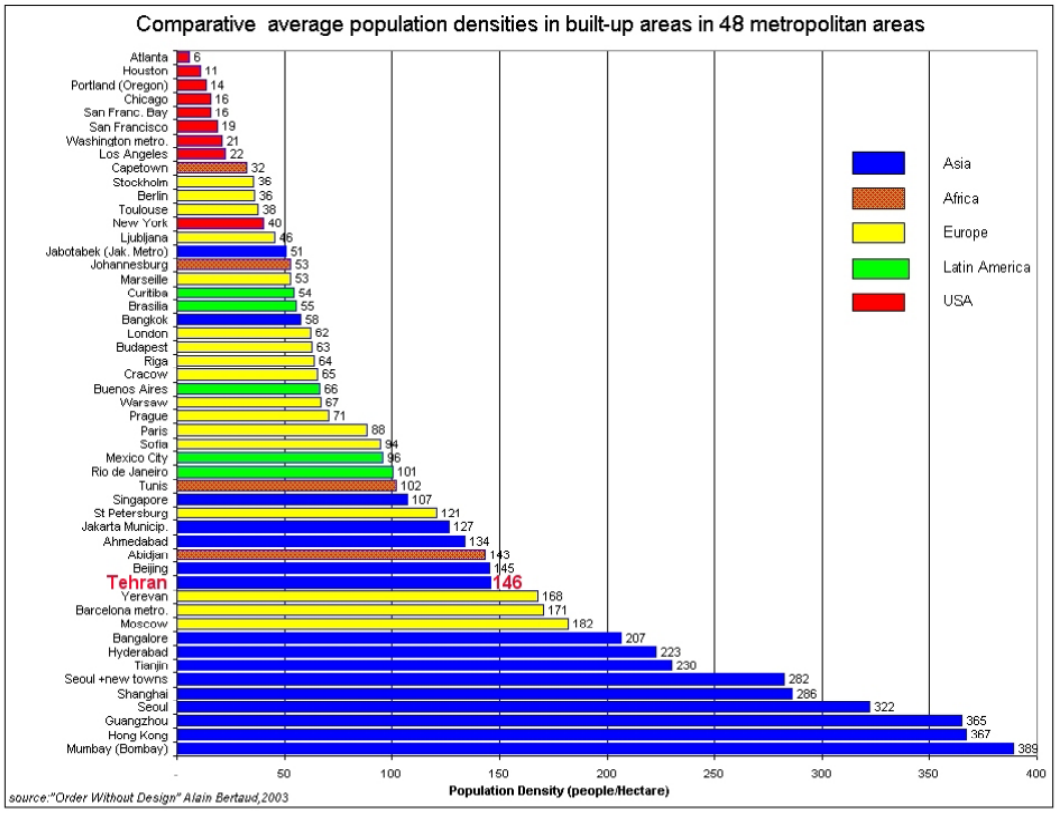

Figure 3-5: Average densities in Built-Up areas (Bertaud, 2003)

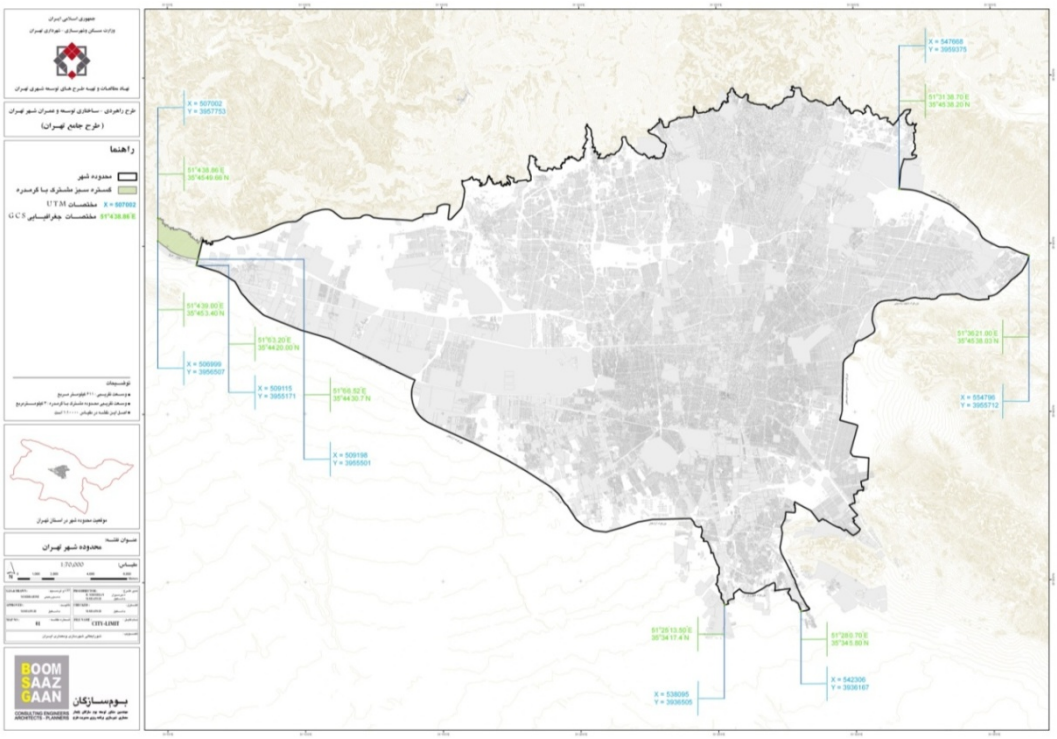

Figure 3-6: Tehran Urban Territory, Tehran Master Plan 2006

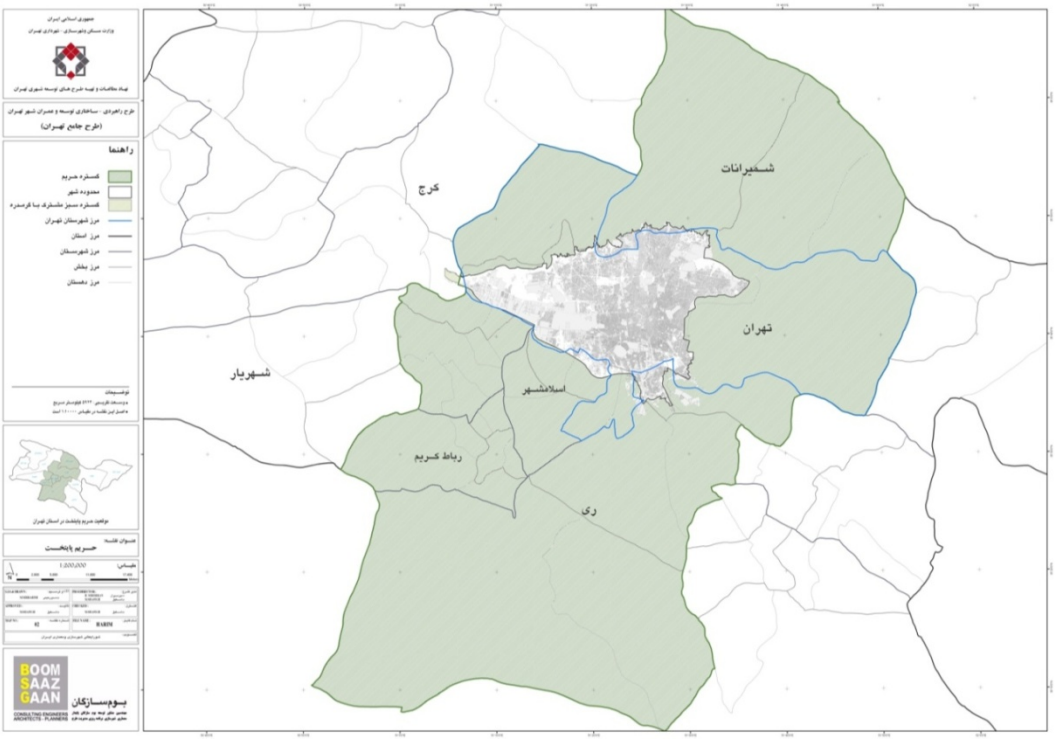

Figure 3-7: The Capital Urban Territory, Tehran Province, and Tehran Master Plan 2006

The Tehran Master Plan (The Ministry of Housing and Urban Development of Iran, 2007) has defined seven visions for the future of the city which are: a city with a 'Persian-Islamic' identity; a knowledge-based city; a green city with widespread and varied public spaces; a safe and secure city against natural disasters; a sustainable city with an apt structure for dwellings, activity and leisure; a city with a sufficient urban infrastructure; and a global metropolitan city with international activities. Several approaches and strategies are proposed to fulfil these visions of the master plan, and some of these approaches might be useful for this research, including: organising and preserving the urban and capital territory and preventing its expansion; improvement of the city's contribution on a national, regional and global level; organisation of the population's housing and social development; economic improvement and 'boom' of the city; enhancement of the transportation systems in the city; protecting the urban and natural environment; securing the city against natural disasters; enhancement of the city's crisis management; improvement of the city's water management; enrichment of spatial organisation in the city; efficiency improvement of the city and surrounding urban areas; conservation of natural and historic heritages; organising and developing the townscape; improvement of green and public open spaces; revitalisation of deteriorating urban areas; and enhancement of urban services for citizens (The Ministry of Housing and Urban Development

of Iran, 2007). From the abovementioned approaches and strategies, only few of them are in the interest of this research, i.e. organising and preserving the urban and capital territory and preventing of its expansion; enhancement of transportation system of the city; protecting the urban and natural environment; organising and developing the townscape; revitalisation of deteriorating urban areas; and improvement of green and public open spaces which mostly cover the spatial issues of the master plan.

3.2.1. Tehran spatial organisation and zoning scheme of Tehran

Since the spatial attributes of the city are the main interest of the research, the spatial organisation of the city is presented here as well as some maps from the master plan. The accepted definition of the spatial organisation used in the master plan is: skeletal vision and clear description of the image of the city in the future and its expansion pattern (The Ministry of Housing and Urban Development of Iran, 2007). The spatial organisation is understandable by its main framework, which is a hierarchy of the corridors (movement channels), centres (city and neighbourhood centres), and areas (urban areas and zones) as the constant components (The Ministry of Housing and Urban Development of Iran, 2007). Mansouri[9] (2006) defines the spatial organisation as the residents' mental image of the city, which is understandable by making a link between the scattered components through a purposeful process. He continues that the spatial organisation is not an imaginary issue but a real dimension of the city that directs the location of the land uses, development direction, and other urban transformations.

The Tehran Master Plan tries to impose a grid structure on the city and believes that the spatial organisation of Tehran is formed by five north–south corridors and three east–west ones. The master plan tries to reduce the effect of the single polar attribute of the current city centre by distributing activities and making several centres all around the city [Figure 3-8]. This fact is confirmed by Bertaud (2003) in his report in which the polycentric attribute of Tehran is highlighted.

[9] Amir Mansouri is the director of the Nazar Research Centre and the director of the landscape architecture department in the Tehran University and was an authority in the Tehran City Revitalisation Organisation (TCRO).

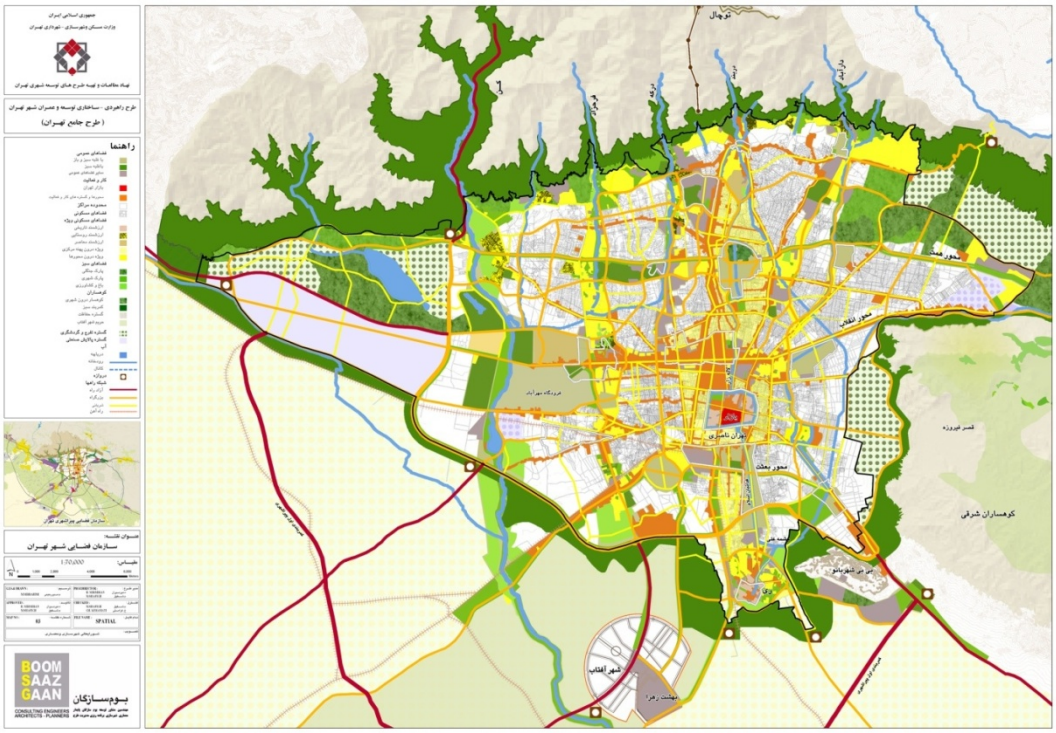

Figure 3-8: The Spatial Organisation of Tehran, Tehran Master Plan 2006

The zoning scheme of the city is the main document in controlling the physical changes and constructions in the urban areas. Four main zones are defined in the master plan including ‘dwelling’, ‘activities’, ‘mixed’, and ‘conservation’ (green and public open spaces). The dwelling zones of the city are about 266 square kilometres in which land use is predominantly residential, and other land uses are restricted or limited, except commercial land use, as this aims to fulfil the primitive needs of each neighbourhood. The activity zones occupy almost 182 square kilometres, in which land uses are predominantly administrative and commercial. These areas are supported by weak and narrow access in highly dense areas and are supported by efficient access and public transportations in the newly built or regenerated areas. The mixed zones are parts of the city, found usually as the result of the expansion of the administrative and commercial land uses in the dwelling zones in the past, which captures almost 47 square kilometres of the city. The conservation zones are the parts of the city with the area of 107 square kilometres and include green spaces, public open spaces, woodlands, gardens and farms, and specific conserved areas in the city, which have a significant role in shaping the image of the city. The main functions of these areas are for leisure and recreation [Figure 3-9] (The Ministry of Housing and Urban Development of Iran, 2007).

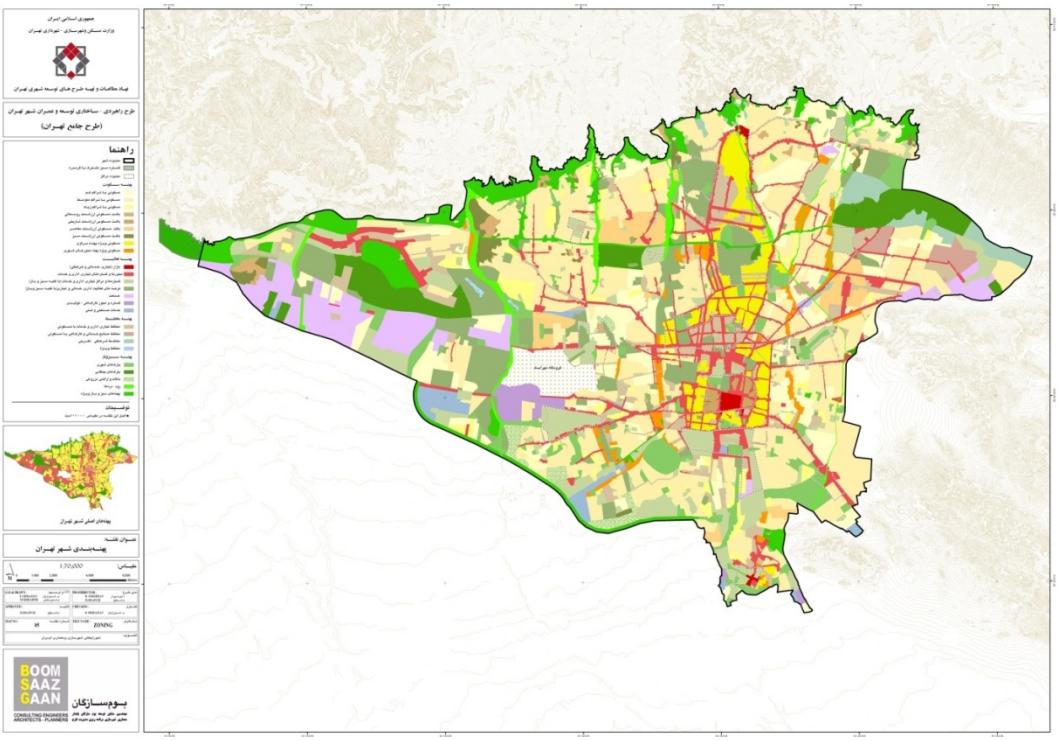

Figure 3-9: The zoning scheme of the city, Tehran Master Plan 2006

3.2.2. **The spatial structure of Tehran**

As Tehran is an old city, its spatial structure has changed over time. The urban development of Tehran dramatically increased from the 1920s at the beginning of the modernisation of Iran. Reza Shah, the ruler of the time, ordered the development of new modern streets, such as Enghelab Street, which cut across the urban fabric, and in many cases, demolished traditional buildings and urban monuments. This trend was also followed by his son and changed the spatial structure of the city dramatically (Ghafari, Coulabadi, 2006). Madanipour (1998) has shown the current spatial structure of the city to be based around several main axes in which Enghelab Street expanded from the west to the east and divided the city into two main parts [Figure 3-10].

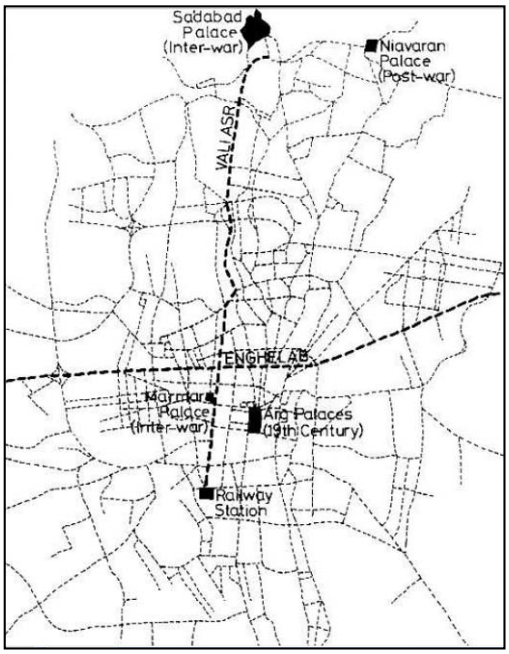

Figure 3-10: Two main axes can be identified in the spatial structure of the city, (Madanipour, 1998)

The spatial structure of a city is the physical outcome of the subtle interactions between land markets, topography, infrastructure, regulations, and taxation over centuries. There are three main features that characterise the spatial structure: the consumption of land per person, the spatial distribution of population in the built up areas, and the pattern of daily trips within the city. The spatial structure of a city has an important impact on economic efficiency and on the quality of the urban environment. For instance, a deficient spatial structure could increase the length of the city infrastructure network and therefore increase its capital and operating costs (Bertaud, 2003). The effect of the spatial structure on urban environment and society is also highlighted by Amayesh Iranshahr Aria[10] (2009) in a report about Nezam Abad[11] Townscape Plan. The report indicates how a north–south street in district seven in Tehran, Shariati Street, divides district seven into two parts. The western parts, with a grid structure, wide streets and big land plots, form a neighbourhood for the upper middle class of society; whereas the eastern part, with a deformed grid, narrow streets and small land plots, makes a highly dense neighbourhood for the lower middle class of society. This is also confirmed by the master plan of the Tehran district seven (Farnahad Urban Planning Company, 2005). What makes the spatial structure of Tehran interesting, is that it is a polycentric city – as Bertaud says - with an

[10] Amayesh Iranshahr Aria is an architecture and urban planning consultant company.

[11] Nezam Abad is a neighbourhood in Tehran

average built up density of 146 people per hectare (p/ha). However, in a polycentric city, the built up density is below 30 p/ha as the result of the absence of a strong centre and the spatial dispersion of employment. This fact is not necessarily a negative one, but it makes some opportunities and constraints (Bertaud, 2003). In the following part the three features of spatial structure in Tehran will be discussed briefly.

3.2.2.1. **Population density and Land consumption per person**

The land consumption per person defines the area that a city requires for its development, and there are two ways to measure the urban density. The first measure is the density by the administrative area and the second one is by the built up area. Bertaud (2003) explained the difference between these two measures in the case of Tehran:

"The area of Tehran Municipality is about 700 square kilometres. As the population in 1996 was 6.751 million, the administrative density in 1996 was about 96 p/ha. However only a part of the land within the municipal boundary is developed, as a consequence when more land is developed the administrative density is bound to increase although the new development might be at a density lower or higher than the current average density. Using the built up density allows to monitor the amount of land which is used per person over the years, it also allows comparison between cities. In this report all densities are built up density which is defined as all areas urbanized, including streets and industrial areas but excluding parks larger than 4 hectares and airports" (Bertaud, 2003, p8/41).

In the Tehran master plan in 1968, Tehran's population was predicted to be 5.5 million by 1991; however in reality it became almost 7.0 million people by this time, about 30% more than expected (Ghafari, Coulabadi, 2006). Although, the population of Tehran increased from almost 1.5 million people in 1956 to less than 8.0 million people in 2006. The built up density surprisingly had a reductive trend between 1988 and 2000 [Figure 3-11]. The historical decrease of the built up density in Tehran is the result of high rise building development since 1960, which caused a reduction in residential building costs, increased floor consumption per household and thus increasing the present average floor consumption in Tehran to 25.5 square metres per person in 2000 [Figure 3-12] (Bertaud, 2003).

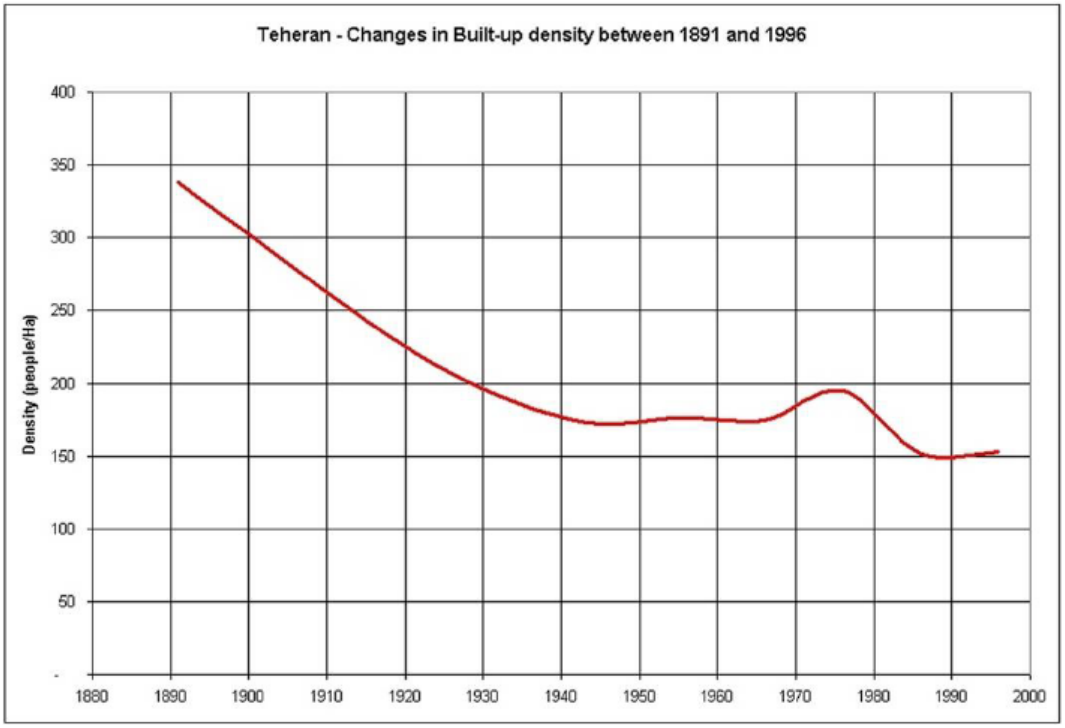

Figure 3-11: Change in built-up density in Tehran Between 1891 and 1996, (Bertaud, 2003)

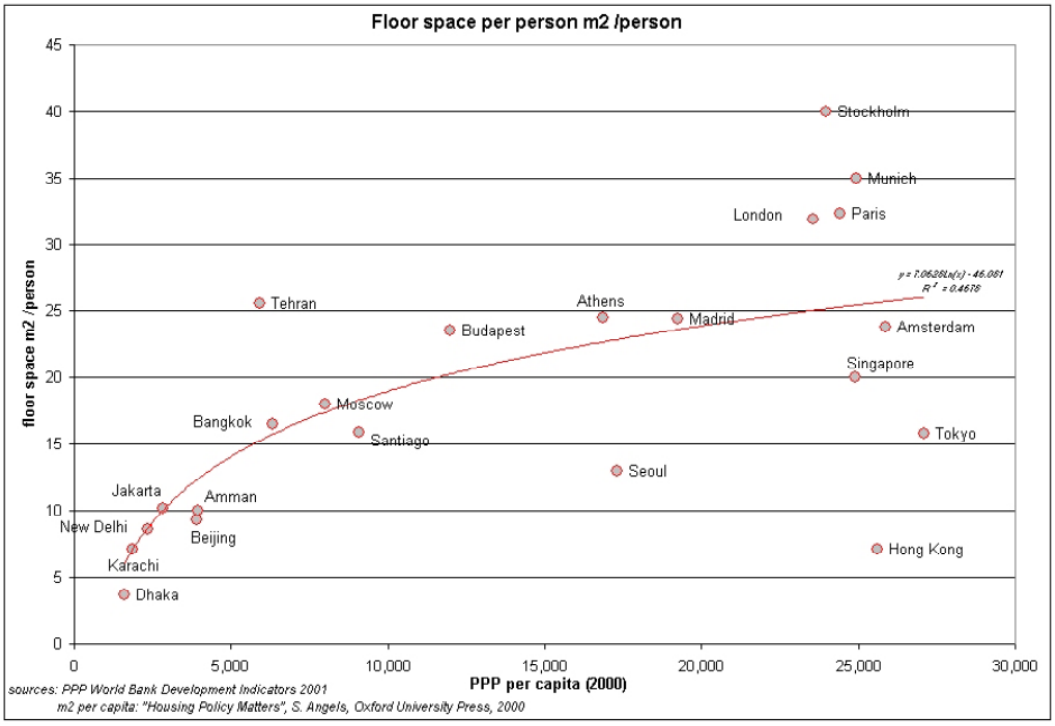

Figure 3-12: Floor space per person, Purchasing Power Parity World Bank Development Indicators 2001, (Bertaud, 2003)

3.2.2.2. **Spatial distribution of population**

The spatial distribution of population is the pattern which identifies the correlation between the Central Business District (CBD), the centre of gravity of population, land use, land price, and the spatial pattern of housing consumption, and it generally highlights the main characteristics of the city (Bertaud, 2003). In the following parts it is verified that the main characteristic of Tehran is that it is a polycentric city. Figure 3-13 shows the population density in the built up area in Tehran. As it shows that the centre of gravity of population in Tehran is located at about 600 metres south east of the crossing of two main streets in Tehran; Enqelab Avenue and Vali-ye-Asr Avenue. Districts six and twelve constitute Tehran CBDs due to the high rate of shopping and work destinations [Figure 3-14, Figure 3-15].

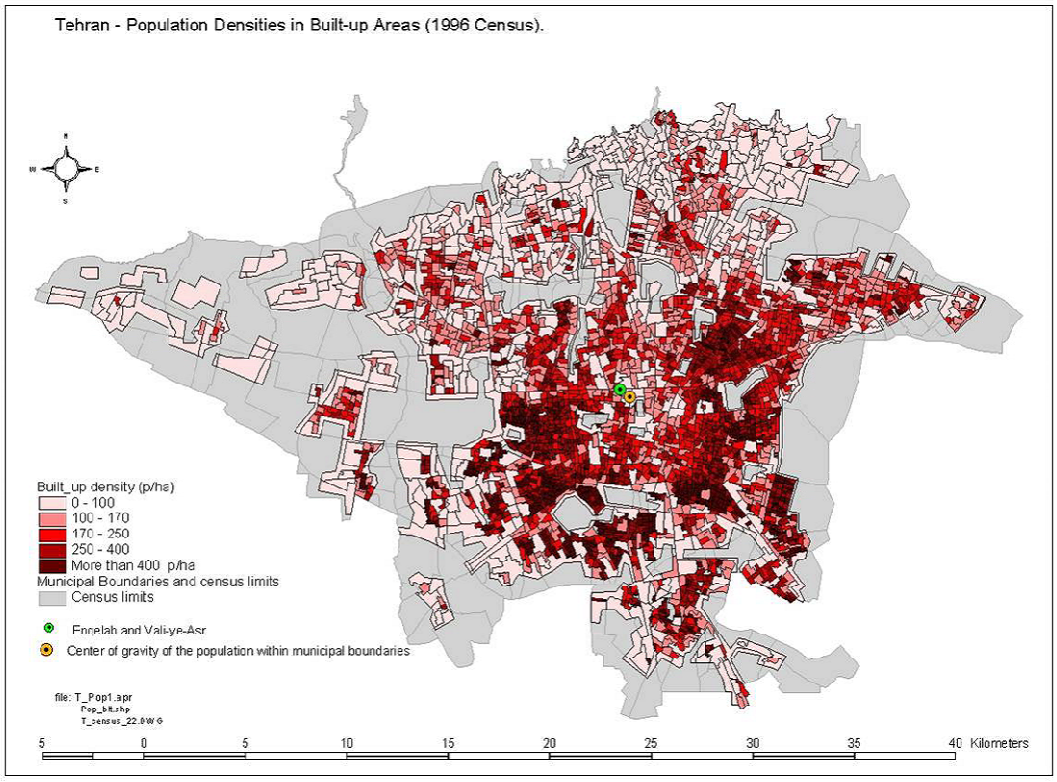

Figure 3-13: Tehran population density in built-up area, (Bertaud, 2003)

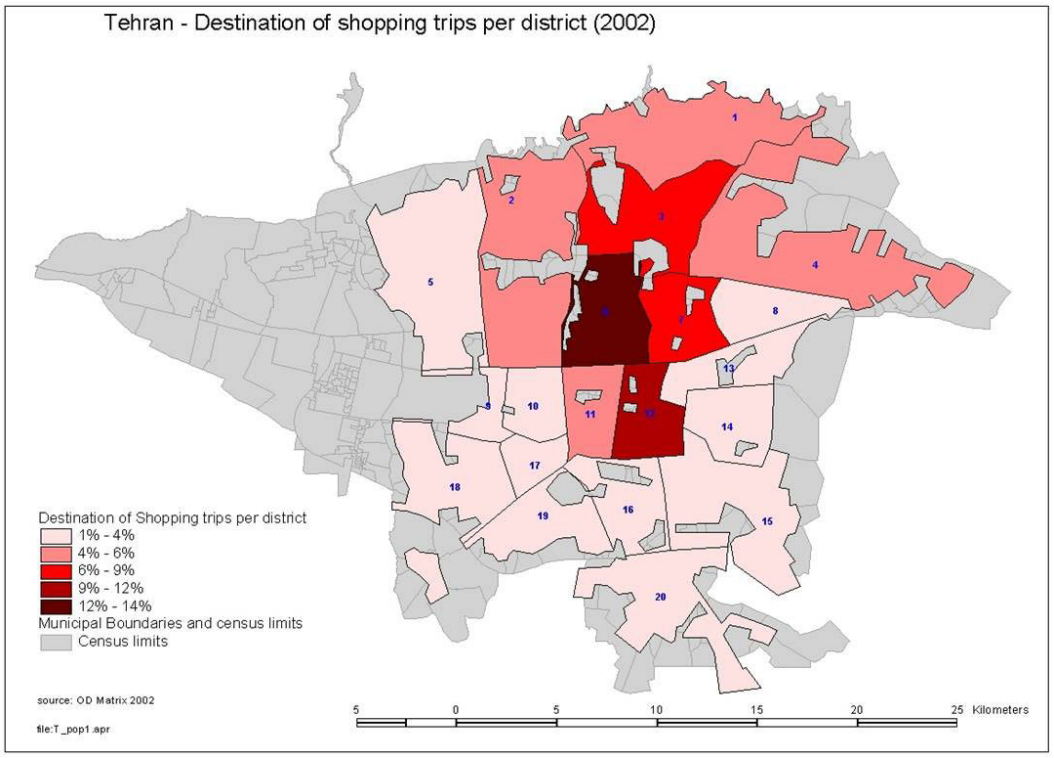

Figure 3-14: Tehran destination of shopping trips per district, (Bertaud, 2003)

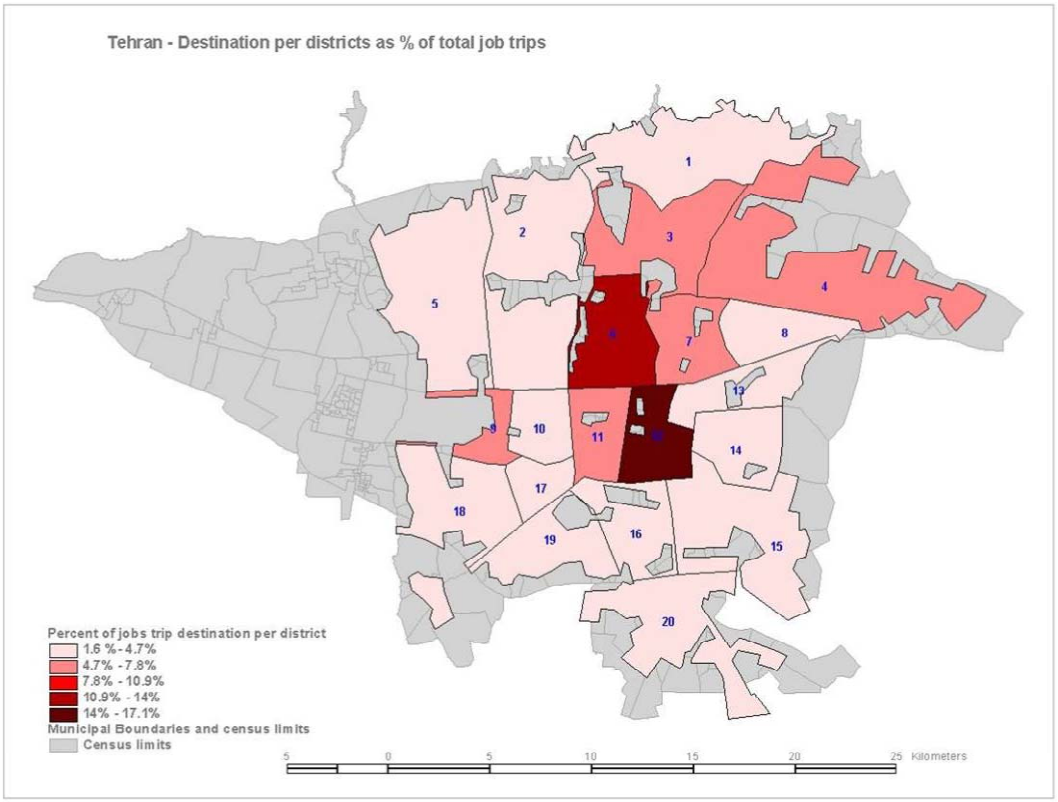

Figure 3-15: Tehran destination of total job trips per district as %, (Bertaud, 2003)

These are all also confirmed by the Tehran Traffic and Transportation Studies Company in 2007. The centre of gravity of population of a city usually coincides with the CBD, which is supposed to have the highest population density in the city. However, Tehran's density profile in the built up area shows that the highest density in Tehran is six kilometres away from the CBD and centre of gravity, which shows a weak CBD as the result of the absence of strong and dominant commercial and business activities [Figure 3-16]. On the other hand, demographic trends show that districts with lower densities have increased their population whereas districts with high densities have decreased their population, showing that the city is going to have a uniformed spatial distribution population [Figure 14]. This attribute is usually associated with polycentric cities in which jobs and retail are dispersed all over the urban area. The pattern of land price also confirms the polycentric attribute of Tehran. The land price profile of a city usually follows the density profile, i.e. the CBD has the highest land price. In the case of Tehran, it seems that proximity and accessibility to the CBD doesn't play a significant role in land price, but the environmental quality does (Bertaud, 2003).

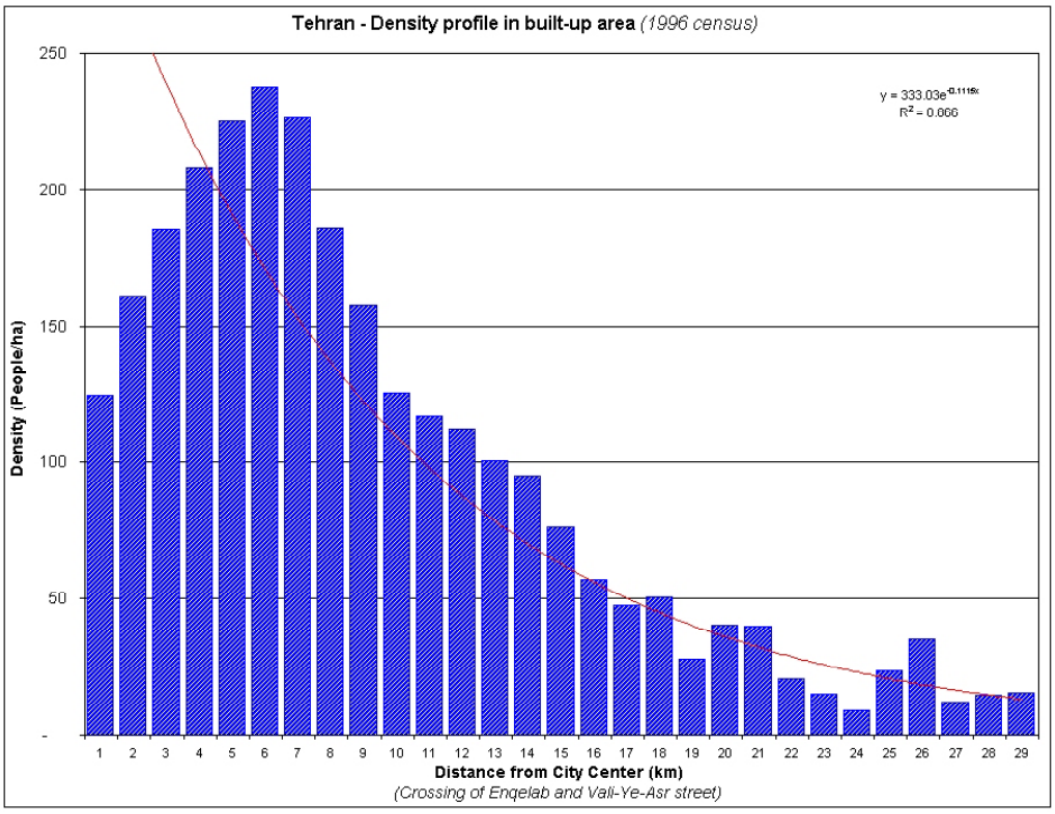

Figure 3-16: Tehran density profile in built-up area, (Bertaud, 2003)

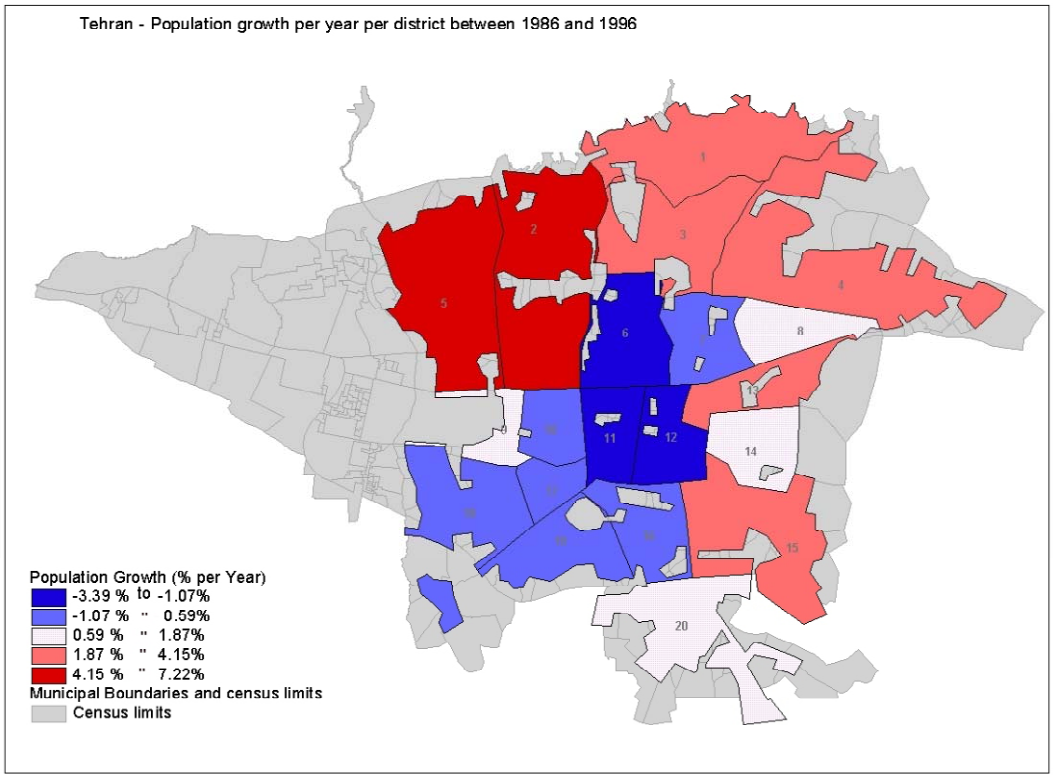

Figure 3-17: Tehran - Population growth per year per district between 1986 and 1996, (Bertaud, 2003)

Figure 3-18, shows that the northern part of Tehran with the better climate due to its proximity to the mountains has the highest land price whereas the districts near to the CBD have almost the lowest land prices. It indicates that the CBD is a weak attractor and that the city is in fact dominantly polycentric with a high dispersion of jobs and retail. As it is evidenced the spatial differential in Tehran follows a hierarchical pattern from the north to the south and the gravity centre and CBD does not play a significant role here. The pattern of households' income [Figure 3-19], floor space consumption [Figure 3-20] and even social segregation follow this hierarchical pattern and support the polycentric attribute of the city (Bertaud, 2003).

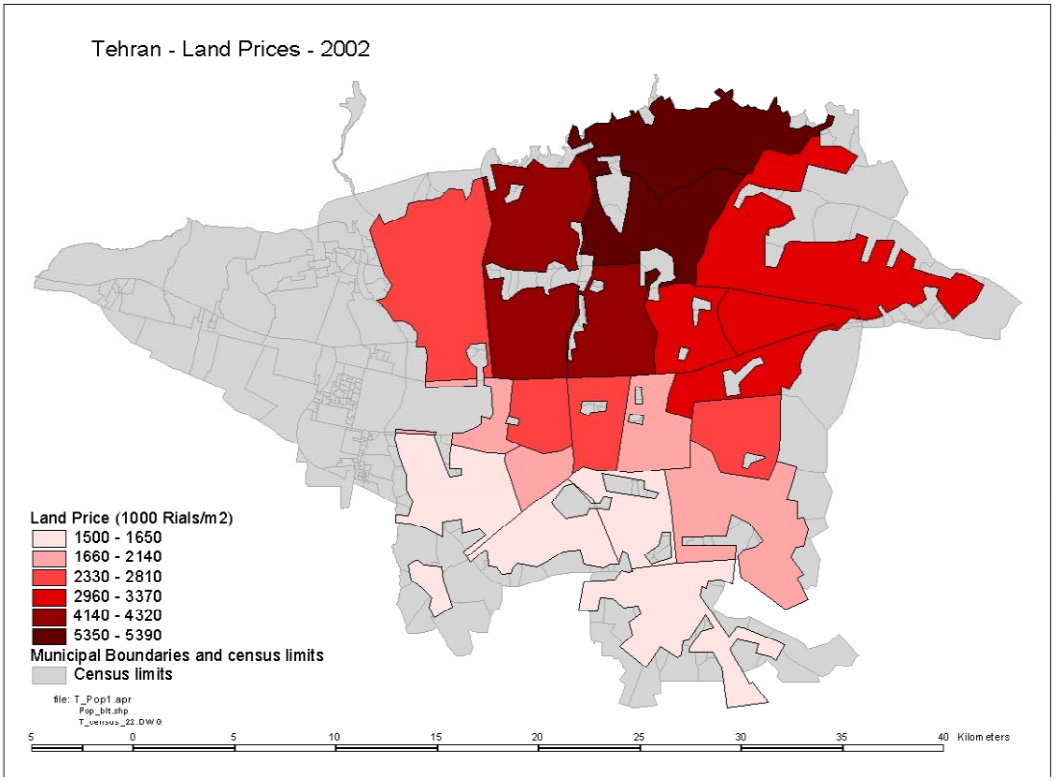

Figure 3-18: Tehran - Land Prices – 2002, (Bertaud, 2003)

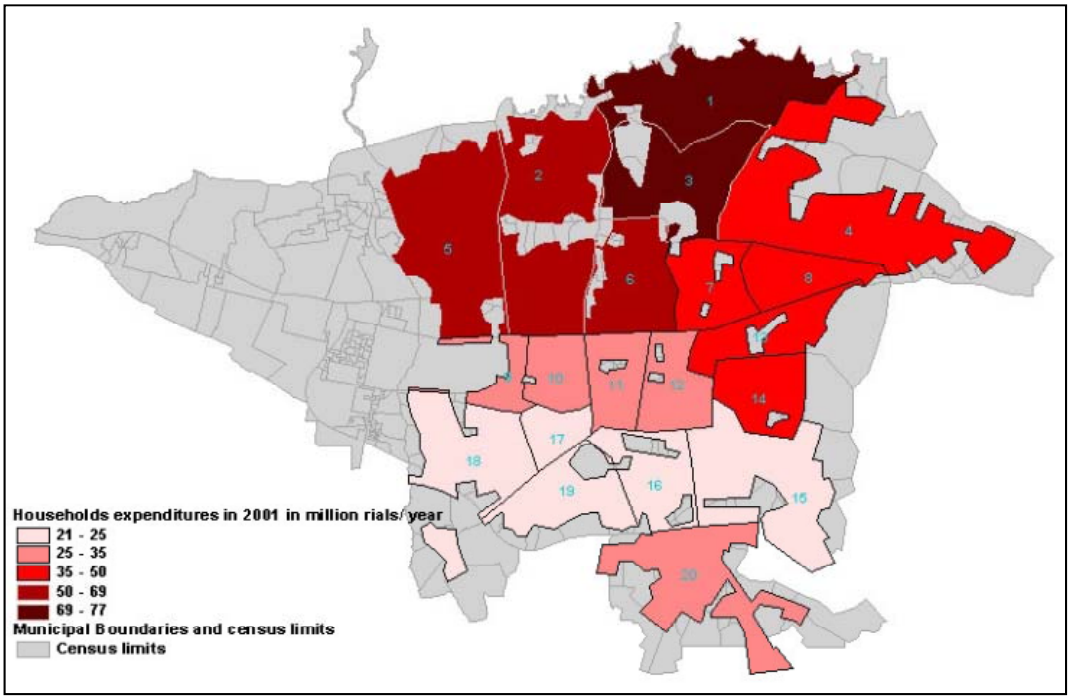

Figure 3-19: Tehran - Households' expenditures 2001, (Bertaud, 2003)

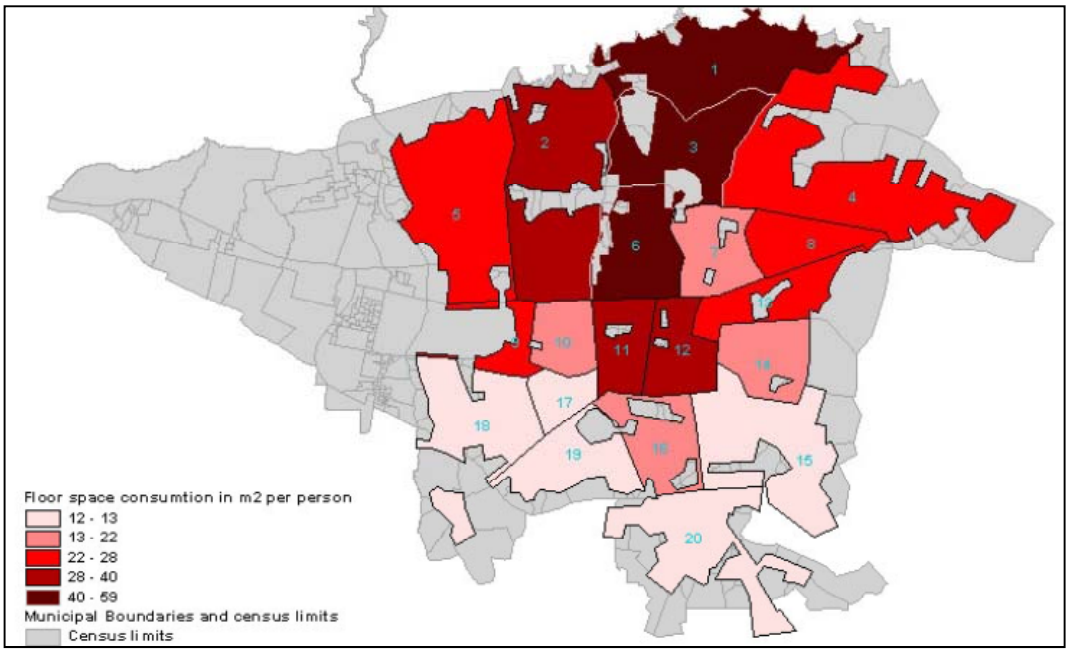

Figure 3-20: Tehran floor space consumption 2001, (Bertaud, 2003)

3.2.2.3. The pattern of daily trip in Tehran

Official statistics show that more than 2.5 million vehicles move along 2500 kilometres of streets in Tehran. Almost 53% of trips in Tehran are made by public transport (23% by bus, 17% by collective taxi and 12% by minibus) and 37% are made by private vehicles including cars and motorcycles. There are also 13 million taxi trips approximately each day in Tehran, of which 55% are for work or education purposes (Haj Nasrolahi, 2006). Figure 3-21 shows the contribution of each transportation mode in the Tehran Transportation System in 2007. Bertaud (2003) also reported that public transportations constitute 60% of daily trips in 1996 [Figure 3-22]. Since Tehran has a polycentric attribute that causes job dispersion around the city and has a weak CBD attractor, transport routes have multiple origins and destinations. This makes public transport not as effective as it could be despite the high-density of the city. Thus the most effective type of public transport in Tehran are the 'collective taxis' which can transport between different origins and destinations, and have a flexible route of service based on the peak of traffic. The relationship between the spatial structure of a city and the effective mode of transportation is shown in Figure 3-23; it shows that public transportation such as a metro would work much better for mono-centric cities with a high-density (Bertaud, 2003). It could be concluded that most trips in Tehran are made by public transport, with a high

proportion of ‘collective taxis’, which shows a large presence of people in streets and public open spaces.

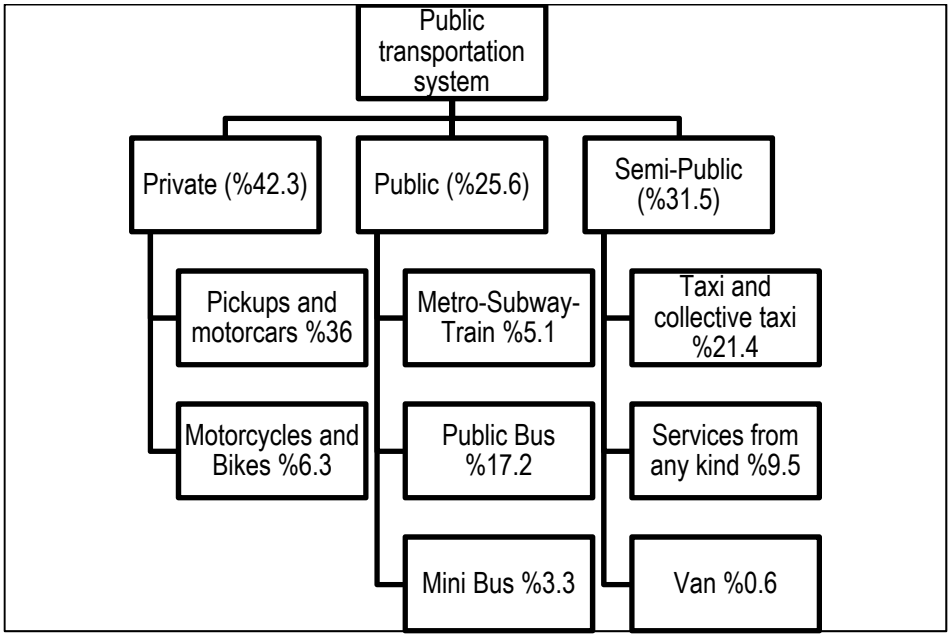

Figure 3-21: Daily Trip Distributing in Tehran Transportation System 2007, (Tehran Traffic and Transportation Studies Co., 2007)

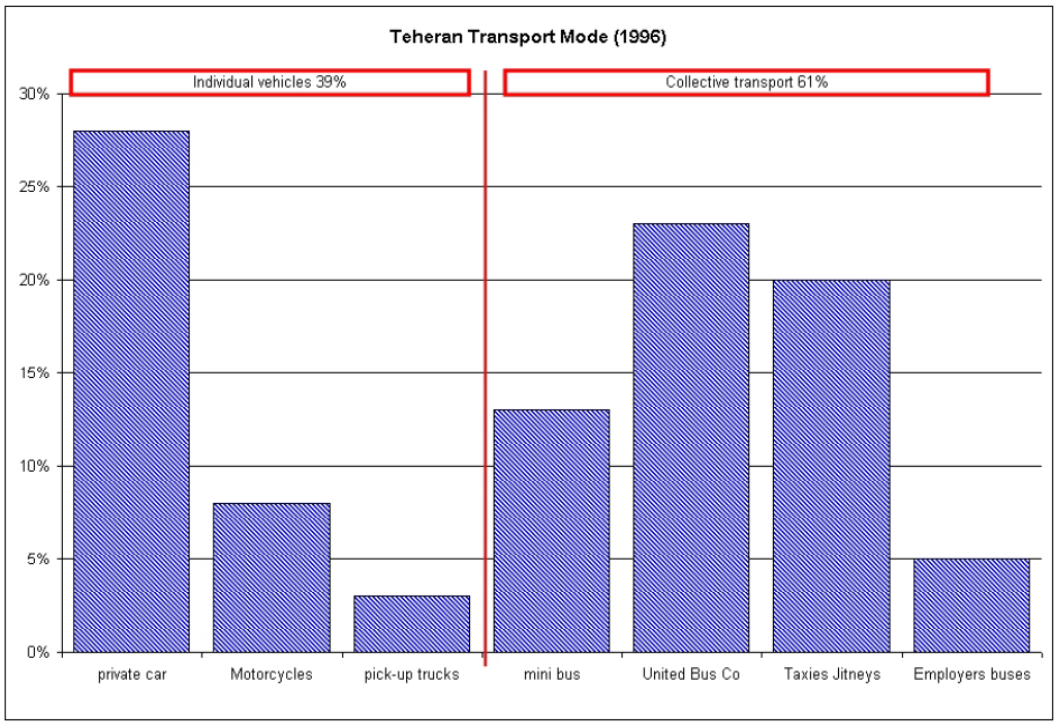

Figure 3-22: Tehran - Transport modes (1996), (Bertaud, 2003)

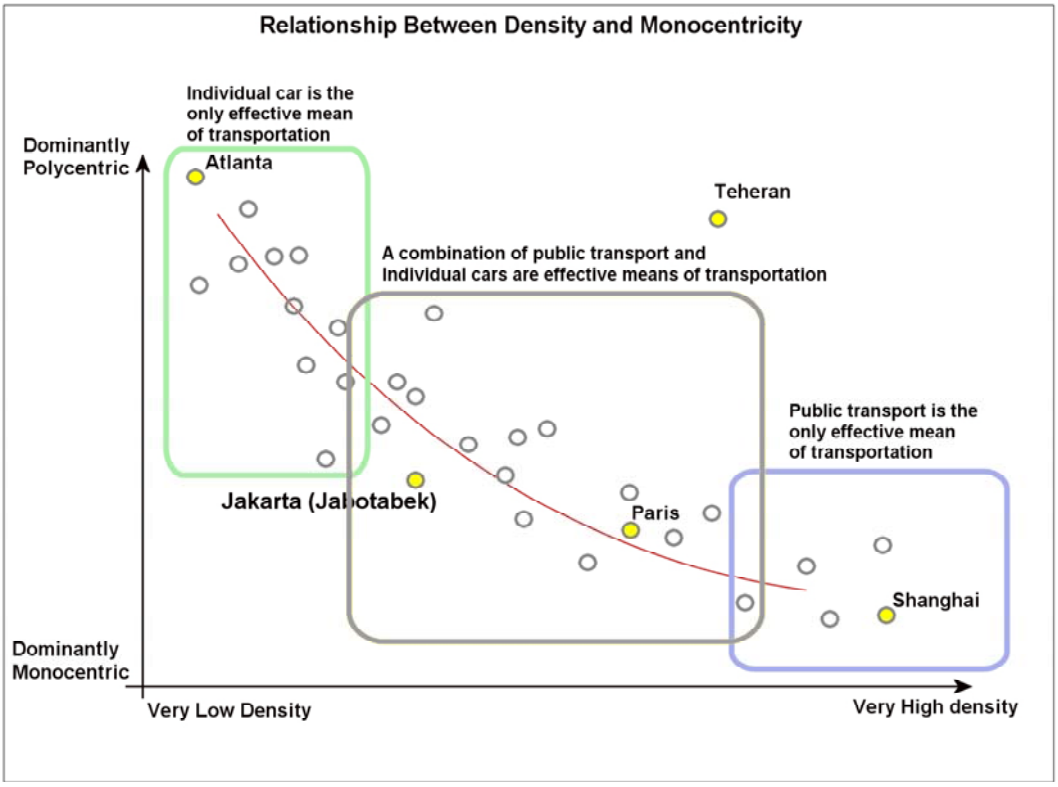

Figure 3-23: Relationship between spatial structure and the effectiveness of public transport, (Bertaud, 2003)

3.3. **Tehran Deteriorating Urban Areas**

The dramatic urban development over the last 80 years was driven by the inward movement of two main groups of people to Tehran. The first group were government employees who were attracted to the north of the city where there is a good microclimate, and the second group was of immigrants from rural areas attracted by better job prospects and quality of life and who settled in the old neighbourhoods in the south of the city. Since then a bipolar organisation has shaped the city, including the north, with high quality housing and a good level of public services and the south of the city with much smaller and poorer quality housing and a low standard of public services (Motawef, 2006). Over the past three decades immigration to urban areas in Iran in general, but especially to Tehran, has increased considerably and led to accelerated urban development and the creation of large areas of spontaneous or squatter settlements, mostly with no coherent layout, a dense building fabric, narrow streets and inadequate access into the adjoining neighbourhoods – most of these areas are officially referred to as 'deteriorating urban areas' (Azimi, 2004, Andalib, 2007a). In this section the deteriorating urban areas in Tehran, their characteristics, and the history of the

renovation plans are presented. Throughout this review, the main interest of this research as well as its contribution to the literature is highlighted.

3.3.1. **Definition of deteriorating and deficient urban fabrics**

There are many terms used in the literature in order to describe the studied urban areas in this research such as 'deficient', 'degenerated', 'eroded', 'degraded', and 'depreciated' urban areas. However, the accepted term for it in the publications of the Tehran City Revitalisation Organisation (TCRO)[12] is 'deteriorating urban areas'. These can be defined as the neighbourhoods in which citizenship and human values have decreased and its residents do not feel safe, secure and are not satisfied in their living environment, and their basic civic needs are not fulfilled [Figure 3-24]. These areas have a variety of problems such as social, environmental, spatial and economic issues that have been present in more than 40% of Tehran's population (Andalib, 2007d). Mansouri (2006) describes the deteriorating neighbourhoods as urban zones, which are identified by the TCRO as a result of specific spatial characteristics, social conditions, vulnerability against natural disasters, and low level of civic services. According to the Islamic Republic of Iran News Network (IRINN), these neighbourhoods occupy almost 3000 hectares of Tehran in which most accesses have a width of less than six metres (IRINN, 2009).

[12] The Tehran City Revitalisation Organisation is the main governmental organisation in charge of the deteriorating urban areas in the city. It acts as a co-ordinator between the Tehran Municipality, the Tehran City Council and the MHUD.

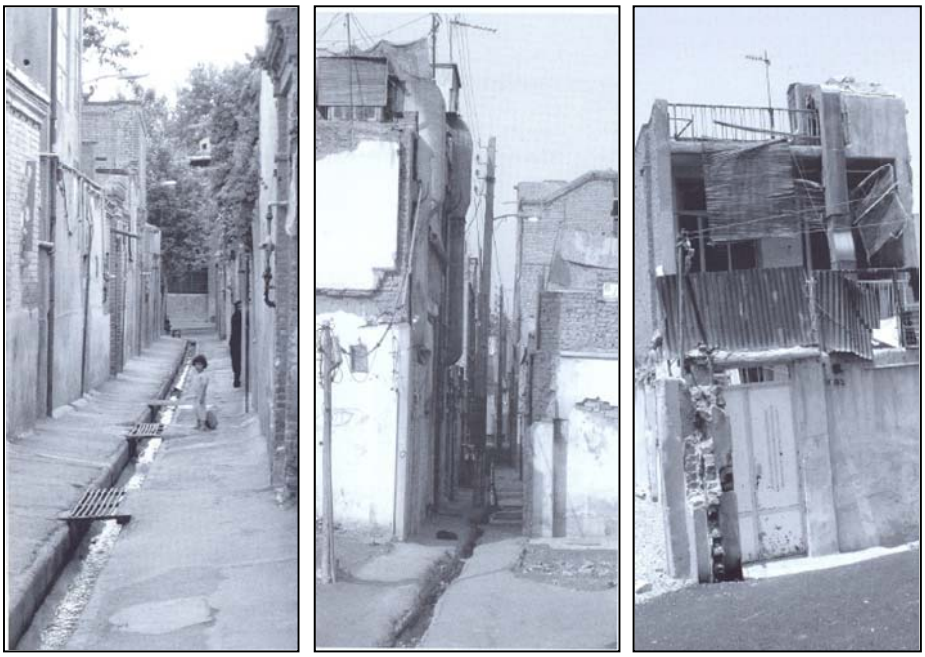

Figure 3-24: The narrow streets and the building conditions in the Tehran deteriorating areas, (Andalib, Haji Ali Akbari, 2008)

3.3.2. **The pathology of deteriorating urban areas**

Identifying the main characteristics and attributes of the deteriorating urban areas can help to clarify the problems and potentials as well as the interest of the research. The basic problem for the deteriorating urban areas is their isolation as a result of poor connectivity, so that they do not participate properly within the urban system, economically or socially [Figure 3-25] (Andalib, 2007d).

Figure 3-25: A view to the vast deteriorating areas in Tehran, (Andalib, 2007b and d)

The main characteristics of these low-income neighbourhoods are: physical condition of structures at the end of their life; lack of permeability into the neighbourhood and narrow streets; lack of civic services for leisure, especially for young people and children; vulnerability to earthquakes and natural disasters; low quality of access; insufficient open space; lack of green space; high level of corruption and crime; low quality of urban infrastructure; environmental pollution; high-density of population, small urban block size; and lack of private sector desire to participate economically due to the low property prices [Figure 3-26] (Motawef, 2006, Andalib, 2007a, Andalib, 2006, Mansouri, 2006).

Figure 3-26: The poor conditions of the deteriorating areas in Tehran, (Andalib, 2007b)

An overview of the deteriorating areas reveals that they occupy almost 20% of Tehran's Municipality and are mainly located in the southern part of the city (Andalib, 2007b). As a result of their specific spatial and socio-economic attributes, the deteriorating urban areas need a special approach in providing the regeneration plans as well. In this regard, a comparison between urban regeneration projects in a non-deteriorating neighbourhood and a deteriorating one is shown in Table 1 (Andalib, 2006, Mansouri, 2006).

Table 1: A comparison between regeneration in a normal neighbourhood and a deteriorating one

Deteriorating Neighbourhood	Normal Neighbourhood
Renewing is done by revitalisation organisation	Renewing is done by the private sector
Renewing process has time limitation	Renewing process is gradual and time limitless
Renewing occurs in an urban zone	Renewing occurs in some land plots
Renewing the whole neighbourhood is the aim	Neighbourhood keeps its shape and urban form
Renewing process should be justified financially	Renewing does not need any financial justification

Table 2 shows a comparison of the civic services and land uses in the deteriorating urban areas and Tehran city average. It highlights the serious lack of urban infrastructure in the deteriorating areas, such as public open spaces and civic services, and the necessity for reducing the land uses and insufficient street networks for the benefit of effective public open space (Andalib, 2007b).

Table 2: The comparison between the deteriorating urban areas and the Tehran city average

Land Use	Deteriorating Areas		Tehran City Average		Proposed Per Capita
	Percentage	Per Capita	Percentage	Per Capita	
Residential	49.04	18.76	23.54	22.77	20.93
Green Space	3.63	1.39	8.46	8.18	9.12
Civic Services	5.35	2.05	6.03	5.84	10.9
Industrial	2.14	0.82	5.32	5.15	4.84
Official & Commercial	5.3	2.03	3.47	3.36	1.94
Transportation and Warehousing	1.79	0.69	4.49	4.34	5.19
Military	0.24	0.09	7.85	7.59	1.46
Farm Lands	1.62	0.62	2.83	2.74	0
Brown Fields	2.91	1.11	7.8	7.55	0
Other	0.57	0.22	11.48	11.1	0.94
Passages	27.32	10.45	18.73	18.11	24.81

3.3.3. **The contextual factors of deteriorating areas**

Deterioration is not limited to the physical aspects of an area, but is a result of poor life conditions in a neighbourhood (Andalib, 2007a). The main reason for becoming deteriorated is being incapable of renewing the space and function as a result of spatial and socio-economic problems. Since the residents of such neighbourhoods are from low-income families, they are incapable of renewing the building themselves and there is no interest for private sector investment, thus the neighbourhoods are facing a deteriorating process (Motawef, 2006, Andalib, 2006, Mansouri, 2006). The six main effective contextual factors that cause a zone to become deteriorated are economic, social, spatial/physical, environmental, legal, and managerial issues (Andalib, 2007a). The economic issues cause a depression in urban actives as well as reduction in the land price, which makes a good opportunity for low-income families to be accommodated in the area. The social problems reduce the safety and security as well as the life quality in the neighbourhood. The spatial and physical issues cause the ineffective urban infrastructures and civic services. Environmental issues increase the pollution and decrease the life quality and health condition. Finally, the legal and managerial problems make governmental plans inefficient and frustrating (Andalib, 2007a, Andalib, 2007c). Deterioration is not actually a phenomenon, but a process, which includes the whole city. However, some urban zones can be regenerated continuously as a result of spatial, environmental, economic or social attributes and some others go into a continuous loop of deterioration. Figure 3-27 shows the deterioration loop and how a neighbourhood becomes more and more deteriorated. At the first stage, the six contextual factors begin to appear and cause the first signs of deterioration. For instance, a low economic situation of the residents tends to encourage people to live in small houses, and, in some cases, the housing become too small and provides a low quality of life. As another example, social and cultural issues tend to reduce safety and security of public open spaces, which lead to the decline of the public life. At the step whereby people start to migrate to other neighbourhoods instead of regenerating their living area, the neighbourhood goes into a deterioration loop and becomes more deteriorated gradually (Andalib, 2007d).

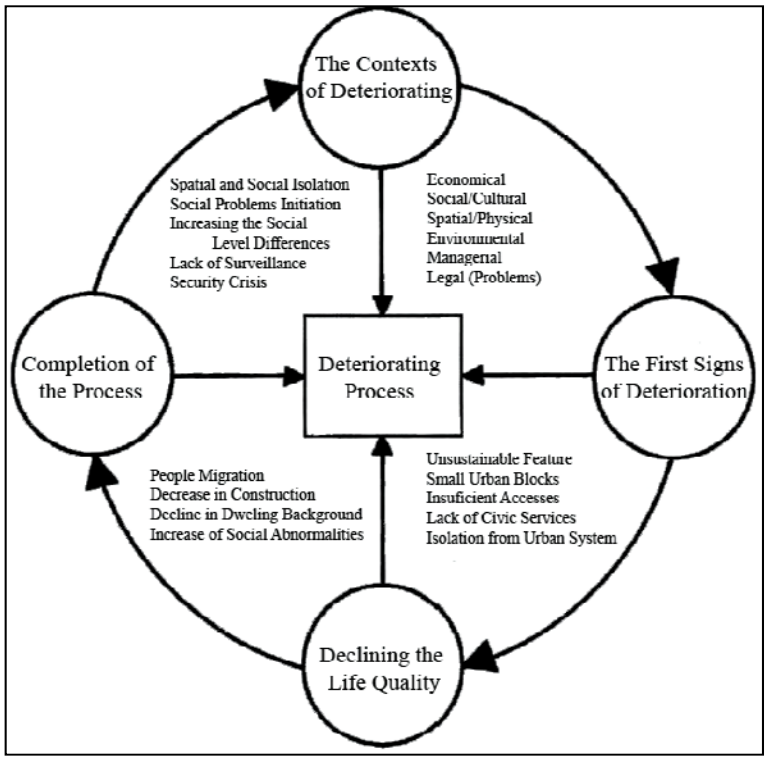

Figure 3-27: The deterioration process loop which decrease the regeneration activities, (Andalib, 2007d)

The deterioration process has several consequences in a bipolar city such as Tehran. Tehran is divided into two parts by Enghelab Street; the northern part is comprised of the middle and upper middle class neighbourhoods, while the southern part is occupied by lower middle class neighbourhoods and, in many cases, low-income families. A difficulty in regeneration plans is the multidimensional attribute of the problem, which makes any regeneration plan difficult. The very basic question would be 'where to start from'. On the one hand, the urban blocks and massive buildings need to be renewed, and on the other hand the accesses and thoroughfares are so insufficient and narrow they do not allow for any construction process to begin. Surprisingly the areas of the neighbourhood occupied by the street networks in such neighbourhoods are even more than the average in Tehran (Bertaud, 2003, Andalib, 2007a, Andalib, 2007c).

3.3.4. **The classification of the deteriorating areas**

Classification of the deteriorating areas can highlight the expected level of intervention by the regeneration plans. Four classes of deteriorating areas are defined by the TCRO. The first class includes the heritage sites with historical and cultural values including urban areas,

which have become deteriorated over time, but they still contain valuable buildings and heritage sites such as the Tehran Grand Bazaar. The second class includes the urban zones that are deteriorated but are not important historically and culturally. The main problem with these neighbourhoods is a lack of infrastructures and civic services. The third class includes the rural areas, which are occupied by the cities due to the urban expansion over time. They have located the urban system and transportation whereas the lifestyle activities found in them still tends to be more rural, such as farming and gardening. The last class involves the self-generated urban areas which are the result of the migration of people from other cities to find a better life, or as the result of migration of the low-income and poor families from the city to its margins as a result of low economic conditions (Andalib, 2007d).

Prioritised areas for regeneration are those in which its residents do not have the desire to renew themselves because of not having legal ownership, poverty, and other reasons. Also, the areas with no environmental or historical value, or isolated areas with specific boundaries such as urban islands and marginal areas, could be added to this list as well. The importance of regenerating these areas is that they have captured considerable parts of the city and the regeneration plans would not be as complicated as for those with heritage sites, and as a result the Municipality can control the city expansion more effectively (Andalib, 2007d).

3.3.5. **The obstacles to successful revitalisation plans**

The Tehran City Revitalisation Organisation reviewed the history of the regeneration in order to understand why the regeneration plans had not been successful. Some of the findings which can help this research to highlight the gaps are as followed. The very basic problem is that regeneration process does not have a defined theoretical framework that co-ordinates the plans and projects, and the TCRO does not have the sufficient knowledge and experience in regeneration strategies. In fact, Tehran did not have a master plan at all for a long time. Moreover, the urban economy of the deteriorating areas is stagnant and remains out of the urban system and discourages the private sector for investment. Additionally, the TCRO and urban planners have not been involved in the regeneration plans actively, and the most important regeneration project that has ever been completed in Tehran was based on traffic purposes in order to develop Navvab Highway, which facilitated the transportation from the north of the city to the south. People and especially residents of the deteriorating areas do not trust regeneration plans due to the unsuccessfulness of projects completed so far (Andalib,

2007d). There is also no specific financial system to help the private sector to invest actively and safely. The regeneration projects have been working divergently without having a same framework or similar purposes. Lack of specific approach and patterns of manipulation, intervention, and regeneration, in addition to spatial problems making projects and construction difficult, are just a few obstacles in the regeneration process (Andalib, 2007a).

Andalib[13] (2006) highlighted the problems of previous regeneration projects in Tehran. He classifies them as: a predominantly economic approach to master plan preparation without considering the real needs of deteriorating neighbourhoods, or the current economic condition of the neighbourhoods. He added some limitations for regenerating projects such as the vast urban area occupied by deteriorating neighbourhoods, having doubt about the effectiveness of regeneration plans, deficient analysis of previous experiences, personal and non-systematic management, insufficient regulations, lack of local participation in addition to private sector and investors, and beginning the projects in the neglected areas instead of enhancing the currently built-up environment.

Although the deteriorating neighbourhoods have so many problems, they could be considered as potentially the best option for Tehran in enhancing the current condition of the whole city due to the huge area they have occupied. The opportunities for the deteriorating areas could be: regeneration as a main concern for the Tehran Municipality and the TCRO, variety of the neighbourhoods as an opportunity to implement new regeneration plans, having the past failed experiences to learn from, the importance of social benefit from the regeneration plans, and the non-economic interest of governmental plans to the benefit of social enhancement (Andalib, 2006). Here, some of the weaknesses, strengths, opportunities, and threats of the deteriorating areas are presented which help to seize the opportunities and deal with problems more effectively (Andalib, 2007b, Andalib, 2007c).

- Weaknesses include: poverty; low land price; high-density of population; multidimensional aspects of problems; huge areas occupied by these zones; time constraints, as the regeneration of infrastructures are time consuming; small urban blocks and land plots which make renewal of plots one by one almost impossible; and

[13] Alireza Andalib is the director the TCRO at the time of this research whose expertise is about urban regeneration.

a lack of infrastructure, especially access and thoroughfares which make the regeneration plans difficult.

- Strengths include: having heritage sites in these areas; low land price to be used for public space; having a considerable population as future residents; being effective in the whole spatial organisation of the city; having the least infrastructure that could be used in regeneration; the existence of sense of place; territory and useful functions such as the mosques; and having the experience public in the areas which makes a sense of belongingness to the place.

- Opportunities include: having the experience of Navvab regeneration project; having the TCRO as an authority in regenerating the areas; having the proposed theoretical framework in the TCRO for regeneration plans; having legislation and regulations reviewed by Tehran Municipality and the TCRO; and having diversity in deteriorating areas which could attract investment from the private sector.

- Threats include: lack of practical experiences; earthquakes and other natural disasters; a bipolar urban system in Tehran; lack of participation; insufficient legislations and regulations; lack of public trust in regeneration projects; lack of comprehensive approach to these areas in the Tehran Master Plan; lack of unity in management; and involving different organisations in this issue.

3.3.6. **The car-orientated regeneration approach: a failed method**

Traffic congestion is a major problem in Tehran so attempts at easing transport movement through car-orientated plans have always dominated regeneration projects in Iran. The first signs of such planning could already be seen in the early 1920s when streets were first developed for vehicles (Andalib, Haji Ali Akbari, 2008). Between 1967 and 1979 the first master plan for Tehran was produced. The Tehran Master Plan of 1969 was the first official document to give priority to deteriorating areas. Since then many urban highways have been developed and many streets have been widened into four lanes. However, the accompanying social or economic regeneration actions were few, dispersed, or focused on reconstructing poor quality housing along the main streets with large commercial plots fronting the streets while poor housing remained behind them (Andalib, 2007a). In the first master plan, 2000

hectares were designated to be regenerated over the following 25 years, up to 1994, and 60,000 people were encouraged to relocate to other parts of the city. However, the plan was not completed because of changes such as the Islamic Revolution of 1979 and the 8-year war between Iran and Iraq. Only one significant project has been set up since, based on developing Navvab Highway, rather than regenerating the urban areas themselves. Although this project is more about transport development and cannot be considered 'urban regeneration', it is the only important project of its kind. It was developed between 1999 and 2003, a highway being pushed through the middle of a deteriorating neighbourhood. However, since the project was car-orientated, just areas immediately along both sides of the highway were renewed and the rest of the area remained in a seriously deteriorating state (Andalib, 2007a). Figure 3-28 shows how the highway passes through the neighbourhood and leads to urban fragmentation, leaving the majority of the area in a deteriorating condition.

Figure 3-28: Navvab Highway which passes through a deteriorating zone was the focus of the TCRO 1999-2003, (Andalib, 2007a)

The history of regeneration in Tehran shows that there was no specific approach to the deteriorating areas and what has been done so far in the name of 'regeneration' is more likely about building renovation and highway developments. This approach was generally limited to few disperse car-orientated projects regardless to the contextual issues such as socio-economic and infrastructural aspects of the area. In the following part Navvab Highway will be assessed briefly from different point of view to support this fact. It is worth bearing in mind that, regardless of all of the weaknesses this project has, it was a valuable experience that can be learned from.

3.3.6.1. **Economic assessment**

The main approach to this project was not from an urban planning perspective and the main purpose of this project was not to regenerate the urban areas but to develop a highway which could direct vehicular traffic to the southern part of the city and its margins. In order to make the best use of this project a series of “affordable housing” constructions were built in the vicinity of the highway. However, since there were not enough neighbourhood services such as shops and schools, the housing market was not as successful as predicted. Nor could the commercial buildings attract private sector funding, since the economic capacity of the residents and the local community was not evaluated in the studies. Finally the project was completed using governmental funding without any private sector participation and investment (Andalib, Haji Ali Akbari, 2008).

3.3.6.2. **Physical assessment**

Since it was a car-orientated project, not enough public open spaces were considered in this project and little attention was paid to pedestrian movement, which was generally ignored in the whole plan, nor was there a hierarchy in access. Therefore streets with no permeability into the neighbourhood are the result of traffic-based studies. Homogeneous architecture next to the highway not only failed to provide affordable housing, but also caused distortion to the market. Lack of connectivity between the neighbourhood and the project was another physical problem that caused urban fragmentation in the area (Andalib, Haji Ali Akbari, 2008).

3.3.6.3. **Social assessment**

There were very few social studies in this project since it developed from a traffic analysis. A high-density of residents allocated to the new apartments. Almost 2000 land plots were bought up and replaced with 6000 residential units by the end of the project as a result of developing apartment buildings along the highway. Having a diversity of social classes with few common interests is another social issue. Lack of public surveillance of public spaces results in unsafe conditions. Lack of public open space, the socio-economic gap between the new residents and other residents of the neighbourhood, and a lack of sense of belonging to the area and a desire to move to another parts of the city are just few of the social problems which could be mentioned here (Andalib, Haji Ali Akbari, 2008).

3.3.7. **Exit Ways from the current situation**

Studying the history of the regeneration process in Tehran could be disappointing at first glance, especially because of the huge areas of deteriorating neighbourhoods with multidimensional problems. However, with a profound look to the literature there are effective approaches could lead and optimise the regeneration process. Having the TCRO as a supportive authority is the most important facilitator of this process of curse. The TCRO have highlighted the 'Exit Ways' of the current situation, including: investing in projects which could have early outputs in the shortest amount of time; investing in projects with tangible outputs for people to attract public trust; understanding the fact that regeneration is not merely renewing and reconstructing the public architecture, but is more about public services and public life; producing a theoretical and practical framework for regeneration projects which could co-ordinate them and make their purposes convergent; and making it clear that why the TCRO should intervene into the desired areas, how this intervention should be done, and what the intervention level could be during the regeneration process (Andalib, 2007a).

3.3.8. **Interventions in deteriorating areas, why and how**

Iran is classified as one of the four countries most vulnerable to natural disasters in the world. According to international reports, 9.28% of Iran's population died in natural disasters between 1992 and 2001. The most common natural disasters in Iran are earthquakes, floods and drought. Throughout 1992–2001, 1146 earthquakes and 610 floods have been reported in Iran (Andalib, 2007d). Since almost 40% of Tehran's population are living in the deteriorating areas, and due to the fact that two of the main attributes of these areas are that they are vulnerable to earthquakes and that there is insufficient access to the site, it is anticipated that huge amount of people could die as a result of an earthquake in Tehran. Crisis management leaves no choice but to take strong steps towards intervention into the deteriorating urban areas with rigorous and optimised urban regeneration plans. With regards to this, in 2008 the TCRO developed a strategic plan for 1200 hectares of deteriorating areas. With an optimistic view, if just 10% of this project could be developed in one year, by the fact that deteriorating areas in Tehran equated to 1200 hectares, about 8% of the city, almost 0.08% of the areas could be regenerated in one year, and this means that the regeneration process for all of the designated areas in Tehran will take 100 years (Andalib, 2007d).

Another reason that highlights the need for intervention into the deteriorating urban areas is the history of the city expansion in Tehran. Considering the fact that the population of the cities are growing noticeably, renewing the inner parts of the city is one of the most effective approaches to avoiding further expansion of the cities (Calthorpe, 2008). Due to the fact that Tehran is a developing city and the deteriorating areas have occupied considerable urban areas in the middle of the city, these neighbourhoods have the best potential in order to prevent more urban territory expansion. Preventing people migration in the city, optimising the urban management, using the current awareness to the importance of the problems in the society as well as the authorities, and unexpected consequences of a probable earthquake in Tehran justify the reasons for the need of intervention in the regenerated neighbourhoods in Tehran (Andalib, 2007d). However, different neighbourhoods require different levels of intervention that need to be done carefully. There are three main levels of intervention accepted by the TCRO in dealing with deteriorating areas, which are 'direct intervention', 'semi-direct intervention', and 'indirect intervention'. Some areas need 'direct intervention' of the TCRO as the main management and supervisory authority that runs economic stimulating projects and controls their regeneration. Some other areas need 'semi-direct' intervention in which the TCRO works just as the coordinator and manager of private sector participation and also supports their investment. In some other areas, strategic plans are proposed to the local municipalities by the TCRO and process of the regeneration and people participation would be controlled as an 'indirect' intervention (Andalib, 2007b).

The area of intervention is one of the crucial factors as well. The literature shows that, in many cases, such big areas are designated for regeneration that the authority is vacuumed financially in the first steps of the project, and incapable of pushing the regeneration forward. By learning from the previous failures, the TCRO has decided to invest in neighbourhood-orientated projects and promote regeneration plans at a neighbourhood scale (Andalib, Haji Ali Akbari, 2008). Since regeneration is a long-term project, the TCRO advocates regeneration as a 'process', rather than a 'project', in which by changing the authorities and the components of the managerial system, the process could continue its work. With this perspective, regeneration is not a project with a starting point and deadline, but a process by which the continuity of it could support the outcome. Moreover, in this approach, the process of regeneration would be more important than the short-term outcome. Such process should be flexible from time to time to be able to co-ordinate different projects. In a process-orientated

approach, ‘decision making’ makes opportunities important, whereas in project-orientated approach, ‘decision taking’ makes decisions by a group of people important. Additionally this approach is not merely renewing the buildings and streets, but it is a socio-economic one that can improve public quality of life. However, the tangible outcome of it can be the physical aspects (Andalib, 2007d).

3.3.9. The theoretical framework for the Tehran regeneration plan

Considering the previous failures, the TCRO has decided to invest in a theoretical framework that considers the residents of the deteriorating areas and their social life, as well as presenting a systematic approach to the regeneration projects. In order to produce this framework the main purpose of the regeneration becomes important since it differs from place to place and city to city.

The main aim of regeneration in Tehran is to preserve urban areas against a probable earthquake and reduce the casualties as well as facilitate the first aid system. This becomes more important in a city like Tehran, in which almost half of the residential units are vulnerable to an earthquake, and the deteriorated areas occupied 20% of the city territory and accommodated about 40% of the city population (Andalib, 2007b). In this regard, basic infrastructures of the neighbourhood, especially street network and thoroughfare development which make permeability and accessibility into the area possible, are highlighted as the first priority. Developing economically stimulating areas that attract private sector participation and facilitate regeneration economically are highlighted in the next place followed by enhancing the quality of public spaces and public life to improve the area socially (Andalib, Haji Ali Akbari, 2008).

One of the main factors to produce such framework is participatory approach, both financially and socially, focusing on public open space and public life. The fact that these areas have occupied a considerable proportion of Tehran’s Municipality area makes it almost impossible for the government to run the regeneration plans without the private sector and participation of people (Andalib, Haji Ali Akbari, 2008). The TCRO reported in 2006 that regeneration of one hectare in Tehran costs 5,500,000 USD, thus the TCRO decided to invest in private sector participation to facilitate the regeneration financially as well as counting on participation. This participatory approach becomes more important in a context whose main problems are

economic and even its social problems are deeply rooted in economic conditions (Andalib, 2007d). In this regard, investing in public open spaces has become the core of the framework since not only it could improve some parts of urban infrastructures but could also act as economically stimulating areas, also making a buffer zone for regeneration, as well as improving the quality of public life and participation of people socially and economically.

Considering that the Tehran Master Plan does not take a comprehensive approach to the deteriorating areas, the TCRO has to develop this theoretical and practical framework that advocates it. Andalib (2006) and Mansouri (2006) both criticised the master plans in their approach to the deteriorating neighbourhoods. The master plan's homogenised approach to the urban zones causes spaces without identity, which in many cases does not fulfil the real needs of a neighbourhood (Mansouri, 2006). The approach to deteriorating neighbourhoods in the master plans usually does not match the reality and it is the same as a non-deteriorating neighbourhood, in many cases, and this shows that the degenerating attributes of these areas are ignored (Andalib, 2006). Another approach which causes even more problems is to consider the deteriorating neighbourhoods as isolated urban zones, producing regeneration plans without thinking of them as parts of the whole urban fabric (Mansouri, 2006).

The TCRO's main visions for this framework are to create sustainable neighbourhoods socially, economically, and spatially; creating neighbourhoods with acceptable life quality and basic urban infrastructure; functional and spatial enhancement of the areas in order to contribute to the whole urban system; and developing a regeneration process by which the residents could feel the difference in both the short and long-term. Additionally, the TCRO have defined four main objectives including retrofitting the neighbourhood and buildings; making a social and economical balance between the deteriorating areas with Tehran's average criteria; investing on revitalisation of the neighbourhood rather than renewing the buildings; and making new capacities and potential for the areas (Andalib, 2007b).

Mansouri (2006) proposed a strategic plan for regeneration called the 'Revitalisation Special Plan' which follows the Tehran Master Plan's main goals and principles while illustrating more details in its approach to the deteriorating areas in Tehran. This plan is accepted in 2007 after a few editions by the TCRO, and received a legal authority (Andalib, 2007d). This plan has three levels including a detailed plan, townscape plan for the neighbourhood, and a management and implementation plan. The main difference of this plan to the master plan is

its emphasis on neighbourhood-orientated plans, which is highlighted as the 'townscape of the neighbourhood'.

The detailed plan emphasises the spatial organisation of both the city and the deteriorating areas and tries to recognise the potential role of these areas in the whole spatial organisation. This approach tries to consider both holistic and local regeneration plans. By a holistic view the plans consider these urban areas as part of the whole urban fabric and produce more unity between urban spaces and make the deteriorating neighbourhoods contribute to urban activities. Additionally, since these neighbourhoods have specific socio-economic and spatial problems, having a local approach helps to fulfil their real needs and obtain considerable achievements (Andalib, 2006, Mansouri, 2006).

Mansouri (2006) proposed the spatial organisation of the city as the pivotal concept that could direct both holistic and local regeneration plans, the approach that is advocated by Andalib (2006) as well. By considering the spatial organisation as the pivotal concept in regeneration plans it is more likely possible to see the city as a system in which every component, including deteriorating neighbourhoods, have a specific contribution to the whole system. This approach has benefits including transferring the deteriorating areas from isolated zones to parts of the system, and also having a gradual regeneration process without making a conflict in the borders of the neighbourhoods and disordering activities (Mansouri, 2006).

The townscape plan for the neighbourhoods tries to capture the public life of the neighbourhood, social relations, and highlights the spatial and economic potential of the neighbourhood. This approach means the regeneration plans must be considered on a neighbourhood scale and fulfil the real need of residents. It looks to the general existing pattern in the neighbourhood including the pattern of public and social life, the pattern of land use distribution, the pattern of accesses and street networks, and generally the different pattern that shapes the functional spaces in the neighbourhood. The third level goes into more detailed plan and identifies the level of intervention as well as step by step development financially and spatially to implement the projects. Table 3 illustrates each level of this plan.

Table 3: The Revitalisation Special Plan and the purposes of each level (Mansouri, 2006)

Detailed Plan

- Recognition of current spatial organization
- Recognition of effective contextual factors
- Planning the spatial organization
- Identifying the land-uses
- Recommendation for land-use distribution pattern
- Recommendation for the main street network and accesses
- Recommendation for zoning and planning the urban blocks

Townscape Plan

- Basic studies including questionnaires, people participation, and identifying the potentials, strengths etc.
- Socio-economic studies including identifying the capacity of participation economically and socially
- Studies of urban landscape and the 'image' of the neighbourhood (townscape)
- Identifying the pattern of use in public spaces and the spatial structure of the neighbourhood
- Proposing the strategies and approaches
- Designing the spatial organization of the neighbourhood including the centres, street networks and etc.
- Designing the image of the neighbourhood including focal points, edges, paving, facades and etc.
- Design the public space for social interactions and social life including open spaces, pedestrian spaces and etc.

Implementation Plan

- Providing an ID for the neighbourhood and the buildings
- Identifying the levels and the territories of the intervention
- Concluding the designs and plans
- Timing the projects individually

The outputs of this plan are several, more detailed, plans at a scale of 1:500 instead of 1:2000 for each neighbourhood; increasing the feasibility of neighbourhood-orientated actions; reducing the population density in the neighbourhoods and increasing the life quality; considering the economic stimulating zones and land uses in the neighbourhoods; meeting the Tehran average per capita for civic services; predicting the public spaces not only to increase the social life but also to provide the required spaces for first aid actions in case of an earthquake; using all the contextual potentials to enhance the spatial and functional structure (Andalib, 2007d). Although the inner city renewal has been progressing considerably, both theoretically and practically, there are still some challenges that need to be considered. For instance, the reconstruction of the single-story buildings with multi-story ones results in higher-density districts with fewer public services. Considering that these areas mostly are privately owned and already lack adequate public open spaces, the quality of life in these sections will negatively be influenced by high-density reconstruction (Azimi, 2004).

So far the literature of urban regeneration in Tehran was presented and the role of public open spaces was highlighted. In the next chapter the methodology of the research is presented.

4. Chapter Four: Methodology of the research

This chapter discusses the methods that were applied in this research, in order to investigate the research questions in regard to the applied theoretical framework. It starts with an overview to the methods applied in the research and their relation to each other. Afterwards, each of the methods and their application in this research are discussed in details.

4.1. Introduction and overview of choice of methods used in the research

The methodology of the research consists of three main methods, including space syntax; the integration of space syntax and the GIS maps of Tehran; and observational method the combination of which lead to developing the design and planning tool [Figure 4-1].

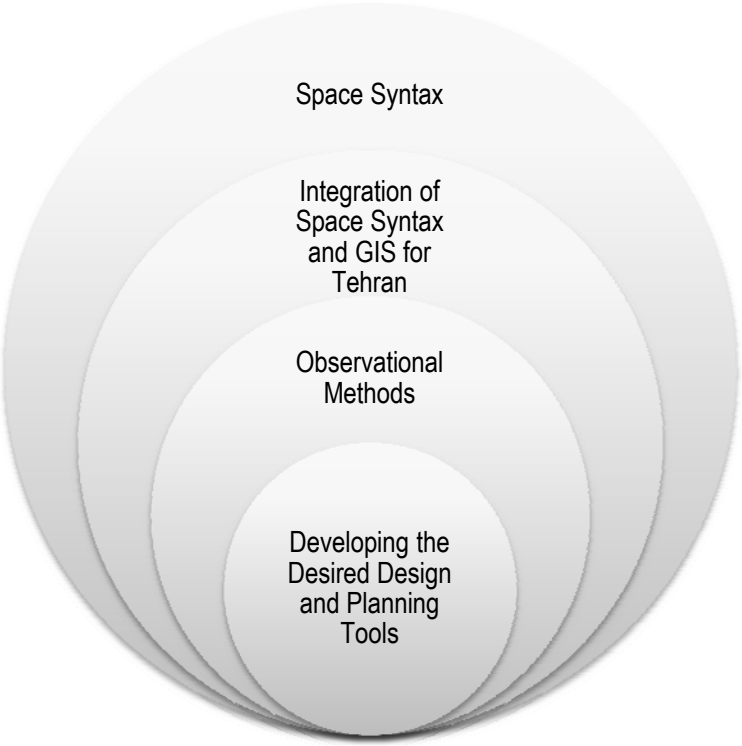

Figure 4-1: Three main methods of the research based on their importance in this research

As Figure 4-1 shows, space syntax is the bedrock of the research method and is the main method which coordinates the methodology of the research step by step. The result of applying space syntax for Tehran is several configurational maps. After applying space syntax for Tehran, the outcome of space syntax was integrated with the GIS maps of Tehran to investigate different attributes of the city including the pattern of distribution of the commercial

land uses. With regard to the relation between space syntax and GIS it can be said that space syntax, GIS modelling, and statistical analysis using SPSS form the quantitative methods of the research by which spatial attributes of the urban fabric in the research context were studied. Space syntax is used to investigate natural movement theory and capture the spatial configuration of the city. GIS modelling is used to make correlations between the syntactic outcomes and the Tehran Master Plan. These methods helped in analysing the spatial structure of the city and highlight the position of the deteriorating areas in the entire city. It also helped to optimise the decisions based on the outcome of the analysis. As a result of integrating GIS and space syntax, a route filtering system was developed in order to select the high potential streets for further development. However, in order to monitor the selected routes, another layer called a transformability index was also developed based on the available socio-economic data from the Tehran Master Plan to link the quantitative methods to the observational methods, as well as the real needs of the residents. In order to apply the methods, two case studies have been chosen to show the potential application of the developed methods in a deteriorating area.

After identifying the spatial attributes of the city and understanding some general rules of urban economy, the social aspects of the streets were studied using observational methods. Behaviour mapping and site observation forms the observational methods of this research. In regards to this, behaviour mapping was conducted to study the level of socio-economic life found in the streets of Tehran, and to identify the pattern of activities and their frequency in people's daily lives. This also helps to highlight the type of expected activities found in the streets after the implementation of any regeneration plan. Moreover, several site observations were conducted, not only in the streets of the deteriorating areas, but also in the streets of the non-deteriorating areas and the neighbourhoods around the Tehran Grand Bazaar. The site observation helped to understand people's lives in the deteriorating areas, and also highlight the activities which can be found in them and those which are missing in the current situation, based on the observed activities in the other areas with the same climatic and cultural background.

4.2. **Applying space syntax for the city of Tehran**

Applying space syntax in research has different steps, which start by providing the accurate maps for further analysis. However, providing the maps is not the main task in space syntax; it

is just the beginning of the work. Other data is needed such as the pattern of distribution of commercial land use, crime, immigrants' quarters, and pedestrian movement to make the correlations, and conduct the in-depth statistical analysis. In the following parts each of the stages of work in this research are discussed.

4.2.1. **Conducting a pilot study in applying space syntax for Tehran**

Careful reviews of the literature of space syntax highlights that applying space syntax in a research depends completely on the research questions, and there is not one specific approach to this method for all pieces of research. Thus, before applying the method, several meetings with people[14] who have applied space syntax in their research were arranged to share the interest of the research and receive some feedback. For the first step, a very low-resolution axial map of Tehran was prepared to see the possibility of the usage of space syntax for the research. After careful assessment and discussions in the meetings, the benefits which could be derived from using space syntax to address the research question were confirmed.

As an outcome of the meetings it was decided to study the Tehran spatial structure by producing an axial map in the first step. In literature of space syntax, Depthmap[15] software (Turner, 2004) is used to generate the axial map automatically. However, since Tehran is a metropolitan city, as well as being large and complicated, the software was incapable of producing such a map. Given that the aim of the pilot study was merely to understand the complexity of the city and to study the probable benefits of applying space syntax in the case of the research, a low-resolution axial map, in which the main streets of the city are presented, was produced in AutoCAD manually and exported into Depthmap for analysis [Figure 4-2].

[14] The people who were consulted were Dr Sucharita Srirangam who graduated from Edinburgh College of Art in 2008 and applied space syntax for her research and Dr Reza Masoudi Nejad who graduated in Brattled, UCL in 2009. He is originally from Iran and applied space syntax in his research about Iranian cities as well.

[15] Depthmap is the software for Space Syntax which can produce an axial line map automatically as well as conducting the segment analysis.

Figure 4-2: The Tehran axial map with the fewest lines, global integration

Another outcome of the pilot study was to consider both the axial map and segment map in applying space syntax, since very long streets, such as Enghelab Street, can be found in Tehran, and these can be analysed with a better resolution by using a segment map. The difference between the axial map and the segment maps is that the axial map is a fundamental object and many of the most important structural properties of urban street networks relate directly to it, such as the scale-free distribution of line lengths. Also, properties like intelligibility are essentially properties of the axial map. However, segment analysis using a smaller angle is much more disaggregated and precise than the axial map, since it takes the centre-lines of the existing streets and so can do more things analytically[16]. Additionally, segment analysis allows us to investigate the choice measure, which indicates how often each line is visited on random journey simulations through the shortest paths, topologically, in the system (Hillier et al., 1993, Hillier, Vaughan, 2007). This map can be very useful in studying

[16] This part is Hillier's answers in respond to a question about the future of segment map and axial map in the space syntax mailing system at the 24th of Oct. 2010 at SPACESYNTAX@jiscmail.ac.uk.

the relation of one neighbourhood with other urban areas since it lets us investigate the permeability of a neighbourhood, meaning that we can see whether the streets with a high degree of choice pass through a specific area or not.

For producing the segment map, the road-centre map extracted from GIS is usually used. Since the only available road-centre line map for the case of Tehran was at the scale of 1:10,000, this map was used to produce the segment map in the pilot study. However, another segment map was produced using the axial map at a scale of 1:2000 for further study which is discussed later on. The segment map was produced by extracting the Tehran road-centre line map from GIS at the scale of 1:10,000 and importing that into Depthmap for further analysis [Figure 4-3].

Figure 4-3: Segment Map, T1024 Choice Measure [segment length weighted]

The measure of global integration was calculated in this map to make a comparison with the global integration, produced from the manually-produced axial map [Figure 4-4]. The main outcome of the pilot study shows that the result of the axial map produced manually is almost

the same as the map produced from the road-centre line map in GIS. As can be seen in the two maps, the most integrated street of the city is Enghelab Street, shown with an arrow, which is located in the middle of the city. Additionally, the two maps show the same spatial pattern in city expansion which starts expanding from the east to the west and then permeate towards the north and the south via the streets with a direct connectivity with Enghelab Street. This suggests the validity of producing the axial map manually for the whole city with a higher resolution for further analysis.

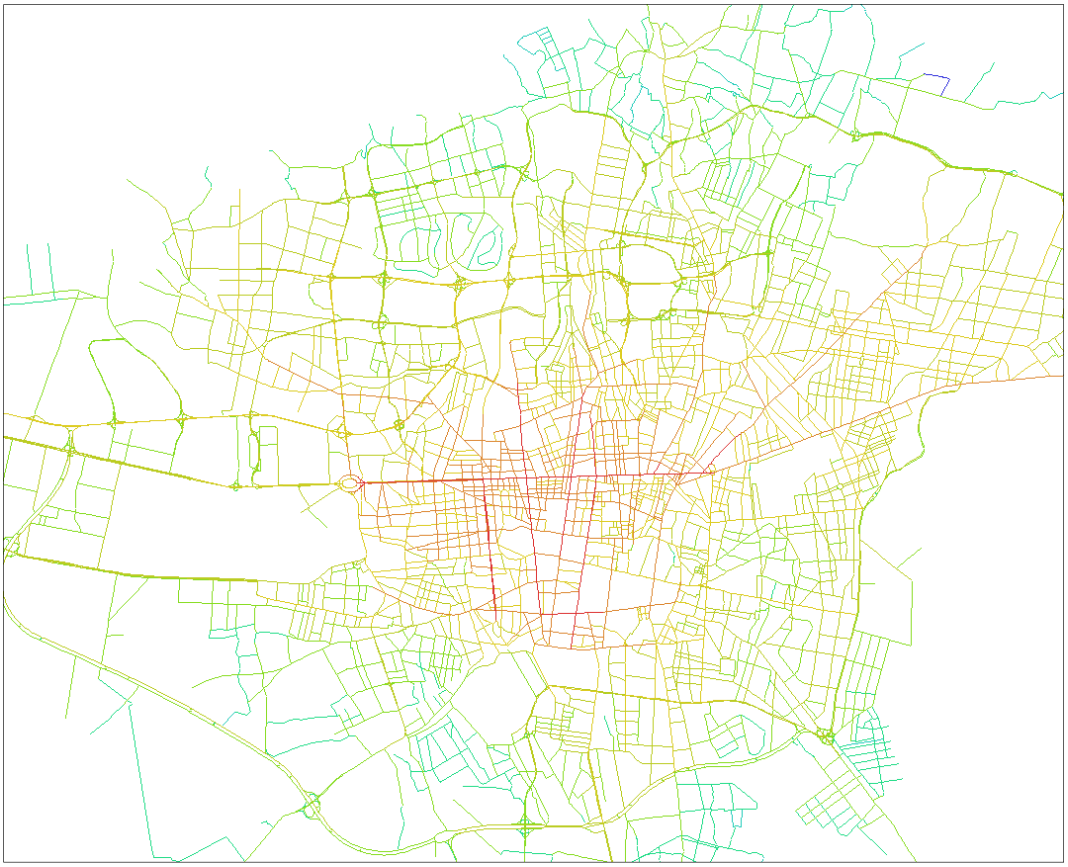

Figure 4-4: Global integration in the Tehran segment map generated from road-centre line 1/10000

4.2.2. **Producing the maps and analytical elements**

After conducting the pilot study the researcher not only learned how to produce the maps and modify them but also realised that producing the axial maps manually for the whole city is reliable enough to carry out further analysis.

In order to produce the axial map for the whole city of Tehran, the city block map was provided at the scale of 1:2000 in GIS. Then, the axial lines were drawn in AutoCAD manually and

exported into Depthmap software. Throughout this process almost 60,000 lines were drawn to cover the whole city. In Depthmap the connectivity map was produced in which the connectivity[17] of each line to all other lines in the map is calculated. At the next stage, as many bridges and underpasses as possible were identified, and where needed, in the case underpasses, the streets were unlinked, and in the case of bridges, the streets were linked to modify the connectivity of the streets (Turner, 2004). In the Depthmap, several measures such as global, local and radius–radius integration were investigated in the axial map. The choice value was also calculated from the axial map for six radii such as Rn, R3, and R7[18] for further investigation. Also the axial map was converted to the segment map to generate metric choice at five radii including Rn, 10,000m, 5000m, 2000m, and 750m. These radii were extracted from the previously performed practices with similar research questions and interests (Karimi et al., 2007) and will be discussed in more detail in the following sections. Finally, all the maps were exported into GIS and overlapped on the Tehran Master Plan for more statistical analysis [see Figure 5-1 to Figure 5-4]. In order to do so, the choice measures produced from the axial map were used for statistical analysis, making correlations with the commercial land use, while the choice measures produced from the segment map were used for a comparative study between the deteriorated areas and non-deteriorated areas. The method is discussed in depth in the following sections.

4.2.3. **Studying commercial plots distribution pattern vs. syntactic measures**

As mentioned in the theoretical framework section, the natural movement theory is based on the relationship between the spatial configuration with movement and attractions [Figure 2-13] (Hillier et al., 1993). In order to investigate the pattern of movement, the literature of space syntax suggests that a pedestrian-counting task should be conducted for the case and a correlation should be carried out between the collected data and the syntactic measures (Desyllas, Duxbury, 2001, Turner, 2007d). However, since it is not always possible to do so, especially if the area of the case study is big or there are not enough resources and materials, the same analysis can be conducted with the available data e.g. commercial land uses as the 'attractions' which in return can cause more pedestrian movement (Hillier et al., 1993, Hillier, Vaughan, 2007). In this research the commercial land use is analysed against syntactic

[17] The number of the connection with other axial lines

[18] R7 is the radius–radius in the Tehran axial map

measures to see if there is any positive correlation between the two or not. This would be more highlighted in this research since the value of socio-economic stimulant zones is highlighted for Tehran's urban regeneration plans as well. This would help us to understand the logic behind the distribution pattern of commercial land use in the city, and get an insight into the current socio-economic conditions of the city.

In order to study the correlation between the distribution pattern of commercial land use and the syntactic measures such as integration, the commercial land use layer was extracted from the Tehran Master Plan using GIS [Figure 4-5]. At this stage almost 67,436 plots were identified as 'commercial plots'. Before conducting the statistical analysis, all the data was calibrated, since the GIS data is produced originally by draftspersons and then overlaid with other layers, so there is a possibility of having minor errors in the data. Due to this issue, the database was checked to see if there were any errors or not, and 270 plots were found with an area of less than 2 square metres. The reason for this might be that in some cases the plots are not correctly attached together in AutoCAD, and GIS identifies the small gaps between them as a plot and calculates an area for that. These 270 plots, almost 0.4% of the total data were eliminated in the first stage, and 67,166 plots were kept for further analysis. It might be also strange to have commercial plots with an area between 2–5 square metres, but considering that in the bazaar the land price is extremely expensive, even the under-stairs shops matter and should be taken into consideration. However these plots are also eliminated after more calibration at the next stages.

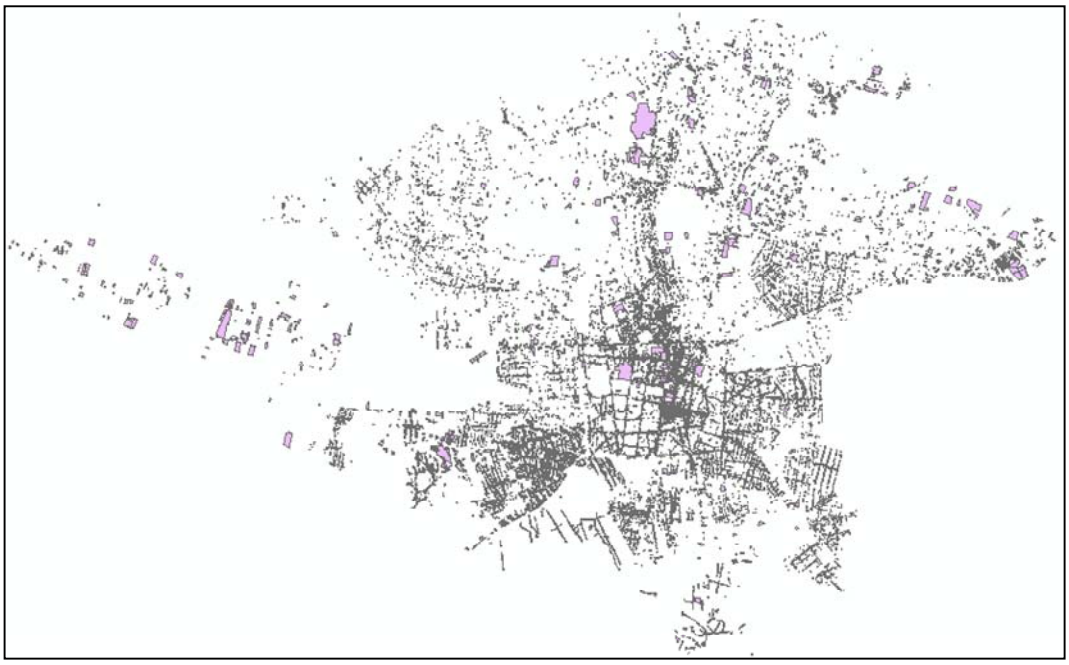

Figure 4-5: The commercial land use plot layer extracted from the Tehran Master Plan

Additionally the Tehran Grand Bazaar neighbourhood was eliminated from the analysis as an exception case. As a result 11,390 plots, 17% of the total data, were eliminated at this stage and 55,776[19] plots remained for further analysis. As Figure 4-6 shows, this neighbourhood is surrounded by the main streets of the grid-structure of the city and consists of lots of small shops adjacent to short, and in many cases segregated, axial lines. The reason for this condition is that in fact, the shops and the bazaar formed the most integrated structure of the old town, but the condition has changed dramatically during the last century as a result of modern car-orientated urban development, irrespective of the socio-economic aspects of the city. Involving this neighbourhood in the data would affect the statistical analysis, thus the neighbourhood was eliminated at this stage. This approach could help us to capture the current logic behind the modern urban development.

[19] This 55776 plot is referred as the statistical population data in the following parts.

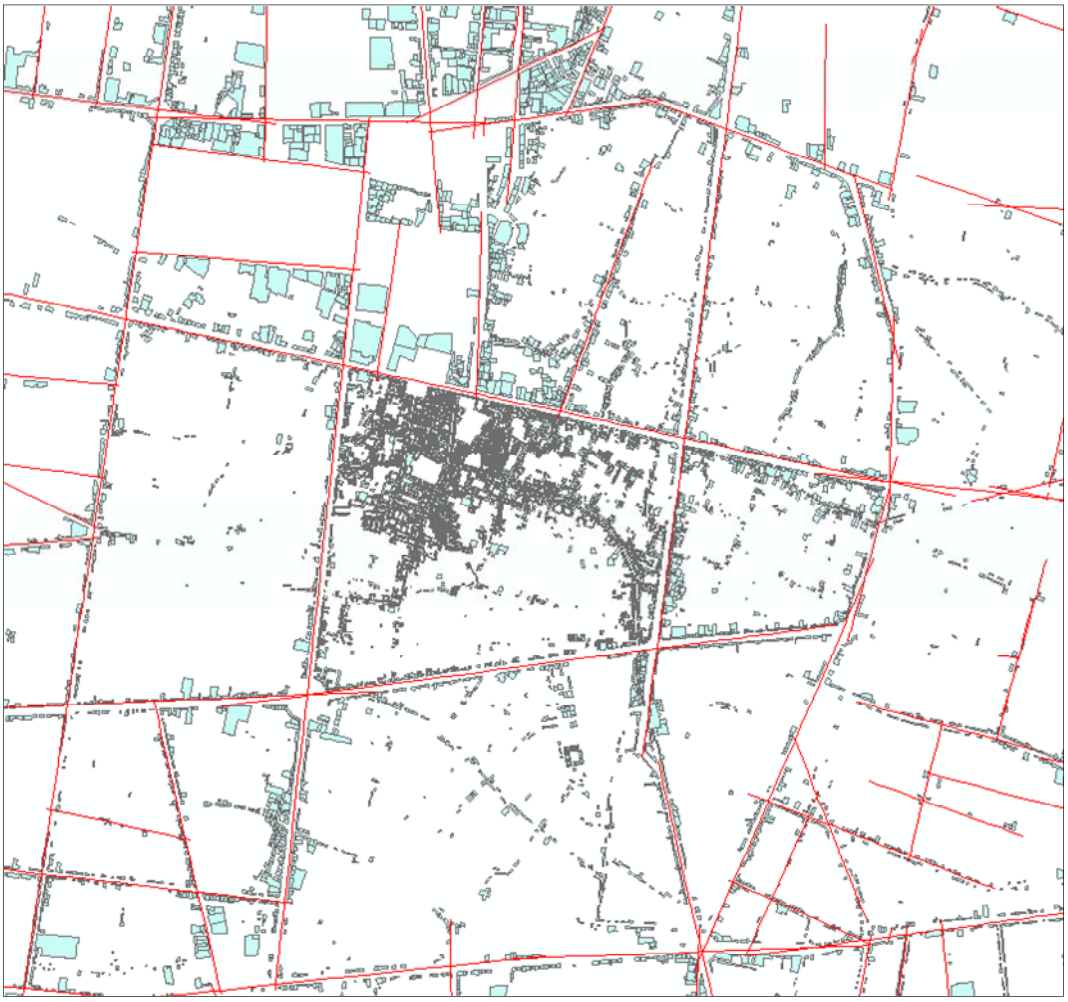

Figure 4-6: The location of the Tehran Grand Bazaar surrounded by the main street

After eliminating the errors and the exceptional case a scatter plot of the statistical population was produced to see the distribution of the data [Figure 4-7]. As can be seen in Figure 4-7 (left), the Tehran commercial land use layer consists of lots of small retailers and shops and few malls, making the distribution of the data abnormal. It shows that urban economy is based on retailers rather than malls and shopping centres – probably an urban tradition which comes from the bazaar. In order to normalise the data the commercial plots with the area above (Mean + SD = 6000 square metres) were eliminated from the database and again the scatter plot was produced [Figure 4-7, right]. In regards to this, 483 plots, or 0.8% of the statistical population, were eliminated as well.

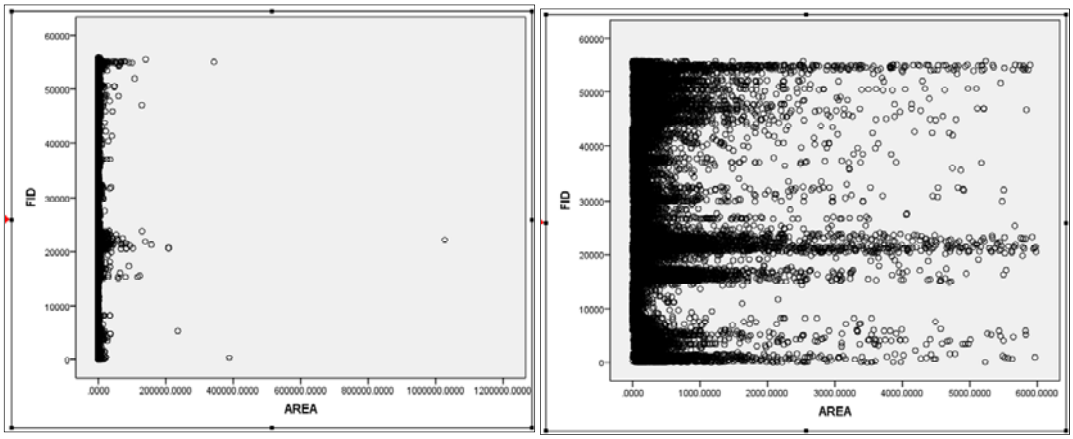

Figure 4-7: The distribution of the statistical population data

Moreover, the commercial plots were modified more during the process of making correlations between the commercial plots and the syntactic measures. In order to make a correlation between the syntactic measures and the 'attractions' the number and the area of the commercial plots were assigned to their adjacent streets. For doing so, a buffer zone from each street in the city was needed to assign the adjacent commercial plots to a street. Since it was not possible to do so for all the streets in Tehran technically, 60,000 axial lines at the scale of 1:2000, the main streets of the city, were extracted from GIS at the scale of 1:10,000 and the same method was applied to them [Figure 4-8]. With regards to this, 1520 streets were selected as those that shape the main frame of the city. At the next stage a buffer zone was needed for each of the streets. In order to have a consistent attribute for identifying the radius of the buffer zone, the width of the streets were used, meaning that the radius of the buffer zone for each street from both sides is equal to the width of the street[20]. Thus, the effect of the main streets in the analysis could be captured more than the effect of the other streets. In this respect, some buffer zones are wider than the others in Figure 4-8. Using this approach makes it possible to have all the syntactic measures as well as the number, total and the average area of the commercial plots assigned to each street at the same time in one map to conduct the statistical analysis.

[20] The radius of the buffer zone from each side of the street = the width of the street.

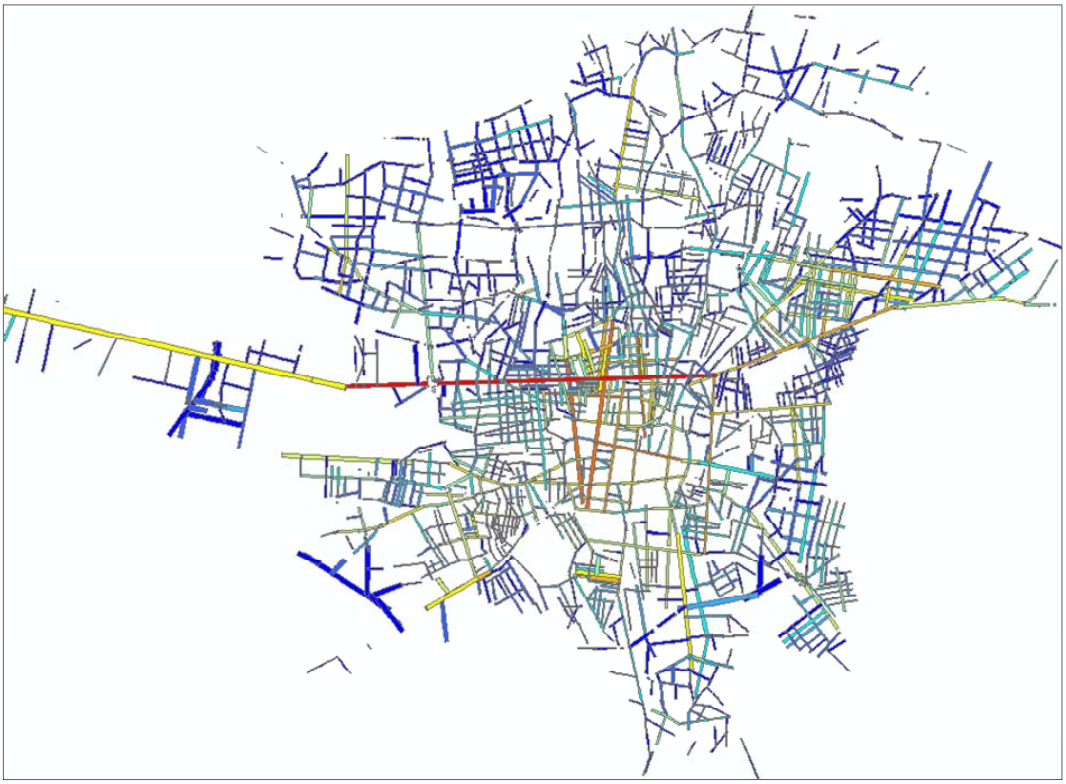

Figure 4-8: The number of the commercial land use plots assigned to each street, 1:10000

At the next stage the commercial plots that had an overlap with the buffer of each street were kept for further analysis and the rest were removed from the database. With regards to this, 50,991 commercial plots, nearly 92% of the statistical population, were left for further analysis. Afterwards, the data was calibrated again by studying the dispersion of the data in the Excel software using linear and exponential regression [Figure 4-9]. The figures show that the exponential regression (R^2=0.97) is more significant that the linear regression (R^2=0.94) and since the regression line is more close to the data trend line in the exponential regression, the relevant equation is used as a base to calibrate the data. With regards to this, the equation was applied to the data and the minimum area calculated for the commercial plot was equal to 10 square metres, so all of the commercial plots below 10 square metres, or 1536 plots[21], were also eliminated from the data. The rest, 97%, remained for further analysis.

[21] Almost %3 of the 50991 commercial plots

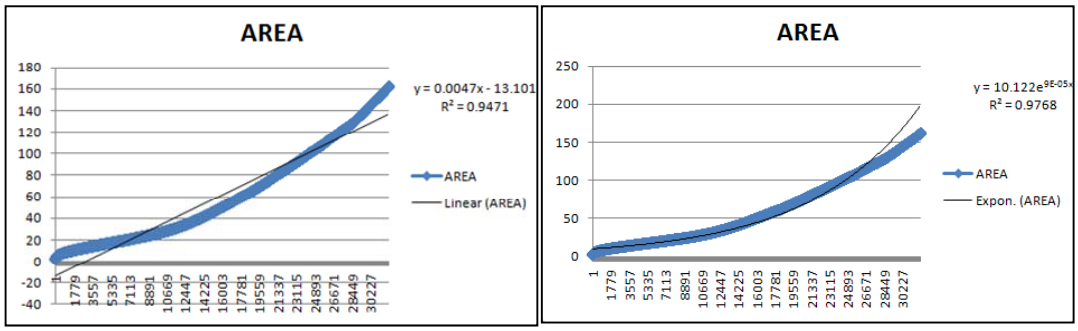

Figure 4-9: Linear regression (right) and Exponential regression (left)

At the next stage the commercial plots were joined to their adjacent streets at the scale of 1:10,000 in GIS and then the whole database was imported to Excel and then SPSS for further statistical analysis and correlation finding.

An issue in carrying out the correlation between the numbers of the commercial plots with the syntactic measures is that the mathematical approach against the commercial plots is the same, regardless to the area of the plot, which shows the importance of the plot in attracting people. For instance, a commercial plot of 100 square metres would be considered as one commercial plot, as would a plot of 500 square metres. This approach does not give a true idea of the effect of the spatial configuration in attracting the commercial plots due to their importance. In fact, good examples of this are the malls, which are located next to the main streets to attract a large number of people. The malls are shown as one commercial plot in the Tehran Master Plan; although in reality the ground floor of each mall consists of many small shops, each of which could be shown as one plot in the GIS map separately. Thus, this research developed a method in which the areas of the commercial plots are considered in the number of the commercial plots.

With regards to this, a certain 'base area' is needed to monitor the commercial plots with. The commercial plots below this base area would be considered as one commercial plot, and the plots above it would be considered as more than one commercial plot. In order to clarify this concept let's use an example. For instance, we agree that 100 square metres is an average area for Tehran's commercial plots, so every shop which is equal to or less than 100 square metres will be considered as one commercial plot whereas a shop with 300 square metres would be considered as three commercial plots. This approach can help to consider the importance of the commercial plots in the equations.

In order to calculate the base area in Tehran, the commercial plots were divided into five classes using natural break method in GIS. Then, the first class, which includes the smallest commercial plots, was selected and standardised. The standardised value was again classified into three classes including Z>1, 1<Z<-1, and Z<-1 (in which Z = the standard value). Then the plots in which their corresponding standardised value was above one were selected, and the mean value of their area was considered as the base area. After conducting this method for Tehran's commercial plots, 180 square metres was selected as the 'base area'. Thus, the commercial plots below 180 square metres were considered as one commercial plot and the ones above 180 square metres were considered to be more than one commercial plot by dividing their area by 180 square metres[22]. After modifying the database according to the above method, the correlation between the syntactic measures and the commercial plots were studied.

4.2.4. **A comparative study between different neighbourhoods in Tehran**

After producing the syntactic maps, several maps were extracted from the Tehran Master Plan using GIS to generate more data and provide more materials for further investigation. With regards to this, a map consisting of 338 neighbourhoods in Tehran was extracted in GIS and exported into the Depthmap software. At the next stage the mean value of each syntactic measure was 'pushed'[23] into each neighbourhood [Figure 5-10 to Figure 5-22]. Then the maps were divided in five layers including 'the city', 'the deteriorating areas', 'the non-deteriorating areas', 'district 07', 'five neighbourhoods in district 07'. This approach makes it possible to have the mean value of each syntactic measure, e.g. the mean value of global and local integration, for each of the 338 neighbourhoods in the city, and conduct a comparative study. It could also make it possible to compare the deteriorating areas and the non-deteriorating areas within the city. It could also make it possible to compare syntactic measures at different radii in one neighbourhood. Such maps were produced for global and local integration, as well as the choice value at radii Rn, R10000m, R5000m, R2000m, and R750m, to have more comprehensive and comparative study.

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[22] The idea of the 'base area' and the method of its calculation was generated with support of urban planners in the Farnahad Urban Planning Company.

[23] 'Push' is a function in Depthmap by which the researcher can assign each value to one polygon.

4.2.5. **Developing a route filtering system**

One of the reasons for applying space syntax in this research is to identify the streets with a high potential in directing pedestrian movement to the deteriorating areas and making more opportunities for the creation of commercial land use, as well as the streets with low potential in this regard for further regeneration activities. Thus, a set of streets, which represent the high potential and low potential streets, should be selected through a systematic approach. With regards to this, a route filtering system is developed in this research. Before going into more in-depth discussions about the route filtering systems, it is necessary to highlight that this research acknowledges that any decision regarding spatial intervention in an urban area needs to be considered from different points of view, such as legal issues, regulations, legislations and current urban policies. However, this research relies on the available data and highlights the spatial and economic aspects as the bedrock of the research for any decision-making. It is obvious that inputting more available data in the method would result in having finer and more accurate decisions.

There are rare references in the literature, as far as the author could cover, which apply the route filtering method, showing that the method is not fully explored and the author had to develop it with an initial approach. With regards to this, Karimi et al. (2007) developed a route filtering system in a research comparable to this one in which the measure of choice at different radii, including Rn, R10000, R5000, R2000, and R750 was investigated. Since Turner (2007) also highlighted the measure of choice to be a more intuitive model for movement than the traditional space syntax measure of integration, this research considered this measure as well as the global and local integration in the route filtering system. However, in order to consider the measures for further analysis and develop a route filtering system on it, the research relies on the outcome of correlations between the syntactic measure and the commercial plots to choose the measures that have the highest correlation. By using this approach it could be possible to choose the streets that have more potential to create socio-economic opportunities as well as directing pedestrian movements[24]. The step-by-step process of developing the route filtering system is as follows.

[24] The results of the correlations are brought in the result section.

The main purpose of developing the route filtering system is to identify the streets in the deteriorating areas where their development could increase the integration of the deteriorating area with the surrounding urban fabric. With regards to this, the axial lines of the deteriorating area as well as its surrounding districts were extracted from the Tehran axial line map. In Figure 4-10, the border of the case study is shown with a black dashed line, and the border of the deteriorating area is highlighted in a continuous black line. The fact that this area is extracted separately does not mean that the research has not considered the area in the whole urban system. In fact, since the axial line of the whole city was produced at the first stage and then the selected area was extracted from it; the area is automatically considered in the whole city structure. At this stage, the research focuses on locally integrated streets since the initial analysis shows that local integration (R3) is more correlated with the commercial plots distribution pattern[25]. Also since the scale of the research is in a neighbourhood scale, it is assumed that locally integrated streets would work better at this scale.

[25] The evidence is presented at the result section in detail.

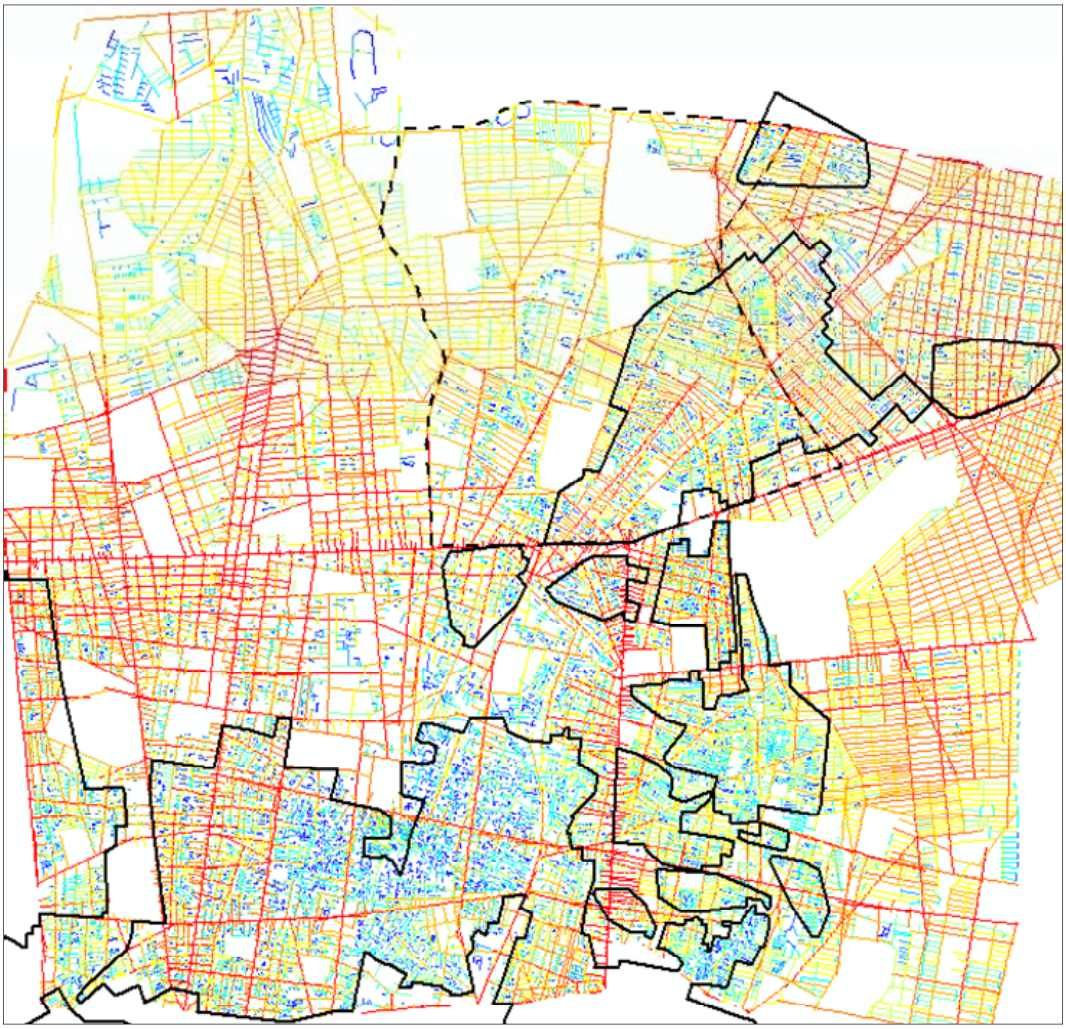

Figure 4-10: The axial lines of the deteriorating area as well as the surrounding urban fabrics, Integration R3

At the next stage, a measure of distance from the mean value of integration R3, expressed as multiplications of standard deviation (SD), was used to filter the routes at the first stage. In order to do so, integration R3 was normalised[26] and the streets where integration R3 was above 2SD distance from the mean value of integration R3 were saved as the main streets of the area, and then eliminated from further analysis. The streets where integration R3 was below 2SD distance from the mean value of integration R3 were eliminated since they probably will change in the re-blocking stage. Afterwards, the streets in the normal distance were classified based on their value of integration R3 in three classes in GIS using the natural break method. The top class with a higher value of integration R3 were saved as the high

[26] Mean-2SD<Local Integration< Mean+2SD

potential streets and the streets in the middle class were saved as the middle potential streets and the streets in the lowest value of integration R3 were saved as the low potential streets of the area [see Figure 5-43 and Figure 5-44].

The aim of this method is to develop the streets in such a way that the streets in the lower class join to the streets in the middle class, and the streets in the middle class join to the streets in the higher class. The high potential street should then join to the main streets. In this process the number of the street connectivity should be passed to reach from one street to the other one is an important issue since it can decrease the mean depth in the syntactic graph[27] and increase the integration. Figure 4-11 shows this process step-by-step.

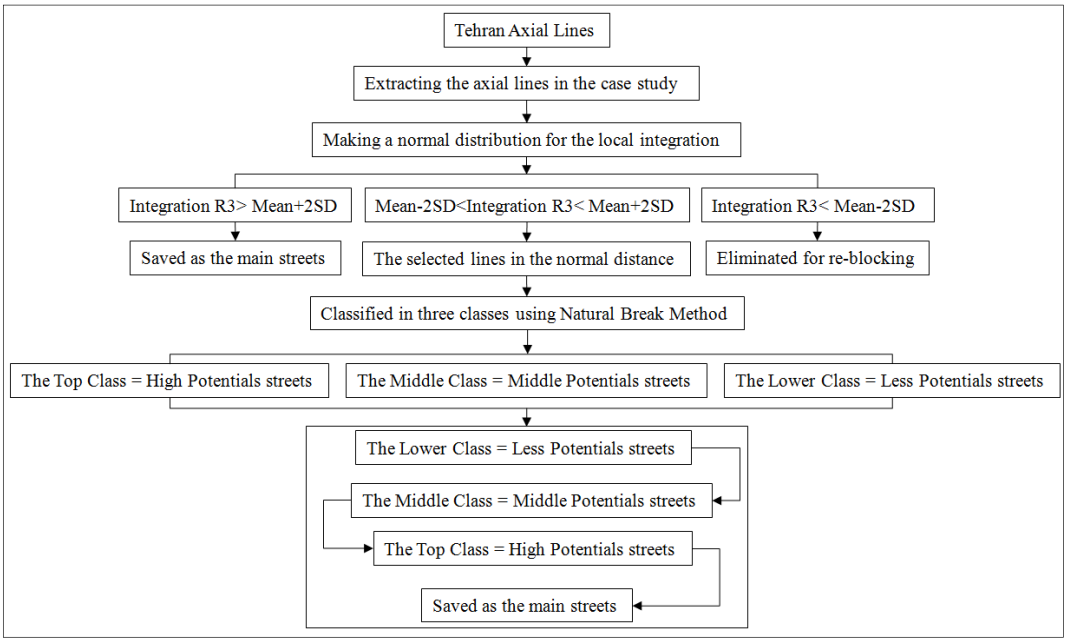

Figure 4-11: The process of route filtering system

In order to control the process of street development and connect the streets together, as illustrated in Figure 4-11, a control layer based on the choice measure at different radii, including Rn, R10000m, R5000m, R2000m and R750 (Karimi et al., 2007) is generated to increase the accuracy of the decision-making, and select the most apt street that could increase the value of both integration and choice at the same time. The reason for this selection is that the initial analysis confirms the positive correlation between both integration and choice with the number of commercial plots [see section 5.2]. This layer makes it possible

[27] The graph discussed in the space syntax section [see Figure 2-11]

to start from one scale, and carefully move to other scales; the approach that fills the gaps in planning from a broad scale to a finer scale. This approach gives an opportunity to overlap all the layers in different radii, and study all the potential streets in each radius in one neighbourhood. In fact, when we overlap all the selected routes in different radii and zoom into the neighbourhood, e.g. the case study, all the high-potential streets in each level are taken into account in relation to the whole city and are highlighted [see Figure 5-48]. All the routes in this map [see Figure 5-48] are the streets that have a high value of choice and act as the control layer for connecting the streets [as illustrated in Figure 4-11]. In fact, by making a link between the control layer and the layers of high, middle and low potential streets in Figure 4-11 it would be possible to choose the streets which have both high values of choice and integration. With regards to this, among the high or middle potential streets, the ones which overlap the lines highlighted in the control layer [see Figure 5-48] should be prioritised meaning that in a case where one comes across two high-potential streets, the one which is overlapped with the lines in the control layer [see Figure 5-48] should be considered as the first priority.

The strength of this method is that it takes each street and neighbourhood into account, in relation to the entire city. Also in the decision-making process it takes different scales, from macro scale to micro scale, into consideration. In order to increase the accuracy of the selection of streets and connecting one to the other, the number of turns to reach from one street to the other in Figure 4-11 is considered, since the increase in the number of the turns can increase the mean depth in the configurational graph of the street network, reducing integration. It is worthy to mention that at first glance it seems that this research is merely working with lines, regardless of considering the social aspects of the area. However, this is not the case at all and a 'transformability index' is also developed in this regard.

4.3. **Selection of the case studies**

In order to study the deteriorating area, two case studies – one covering the deteriorating area, and the other non-deteriorating area as the control neighbourhood – were chosen. Having a case from the deteriorating area could help in studying the position of deteriorating areas in the whole urban structure. However; the control neighbourhood could help as comparative research between the inner-structure of the deteriorating and the non-deteriorating areas. Having case studies helps the researcher to draw conclusions and

findings, which might be generalisable to the other cases, districts or the whole city (Leedy, Ormrod, 2005).

In order to choose the case studies of the research, the most recent Master Plan of the city of Tehran was provided from the Tehran GIS Centre in which the locations of the deteriorated urban areas are shown in red, yellow and light brown [Figure 4-12]. In this figure, Enghelab Street, which crosses from the middle of the city, is shown with the dashed line and the case study of this research is shown with black boundaries. A non-deteriorated district was also selected close to the deteriorated case study as a control area, which is shown with a blue boundary. The reason for choosing a non-deteriorated area is to compare the attributes of the spatial structure of the two cases, highlighting the potential for increasing the integration of the deteriorated area into the surrounding urban fabric.

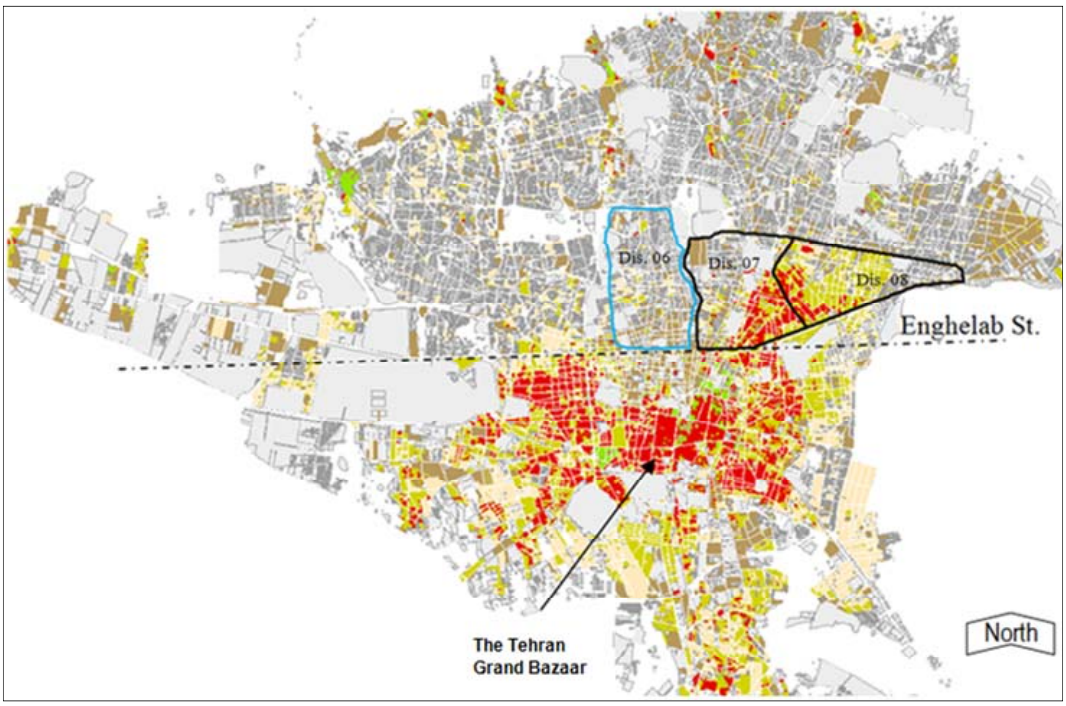

Figure 4-12: Tehran's deteriorated urban areas in the Tehran Master Plan, Tehran GIS Centre

The main reason for choosing this area as the case study is that it is the only deteriorated area in the northern part of the city. Also, all the deteriorated areas located in the southern part of the city are surrounded mostly by other deteriorated areas. However, the deteriorated area in the northern part of the city is surrounded by non-deteriorated areas, which makes it an interesting case. Being surrounded by non-deteriorated areas creates an opportunity for urban regeneration, which requires a morphological study in order to highlight its potential for

regeneration. Moreover, the Tehran Grand Bazaar is located in the southern part of the city and has a great socio-economic and historic influence on the surrounding urban fabric. As a result, any research into regeneration of these areas requires complex socio-economic and historical studies, which are not the interest of this particular research.

As can be seen in Figure 4-12, the deteriorating area is shared between districts 07 and 08 and is surrounded by non-deteriorating areas in the north, east and the west. A highway crosses just from the north of the area and forms the northern border of districts 07 and 08. District 06 is chosen as the control area, the reason being that there is no specific border such as a highway between districts 07 and 06, and the whole area from the west part of district 06 to the east part of district 08 can be seen as one big urban area.

4.4. **Studying the street-life in Tehran**

As highlighted earlier, the emphasis of this research is on the street as a sociable public open space that could deliver socio-economic benefits to the deteriorating areas in Tehran. With regards to this, the type of activities in the streets as well as the pattern and the frequency of them need to be identified. This could help to underline the expected activities to be found in the streets after regenerating an area. It also could help to categorise Tehran's street life using Jan Gehl's classification (Gehl, 2006). For doing so, several methods were discussed in the literature such as recording the activities, taking photos, distributing questionnaires, interviews, focus groups and so on (Ward Thompson et al., 2005). However, not all of these methods could be applied in the case of this research, due to the purpose of the research as well as some other limitations. Therefore, it was decided to conduct observational methods including behaviour mapping and site observations to achieve the research's purposes. In the following section, some methodological and contextual limitations for this choice are discussed.

4.4.1. **Limitations for on-site data collection**

There were some limitations, both methodological and contextual, which led the research to invest in both behaviour mapping and site observations as the main methods of data collection regarding the Tehran street life.

One reason for choosing site observation and behaviour mapping to study the Tehran street life, is that the literature has highlighted the value of carrying fieldworks and observations in filling the methodological gaps to be found in self-report methods, such as using questionnaires and interviews (Bell, Montarzino & Travlou, 2006, Suminski et al., 2007). In fact, it is worthy to say that the author was involved in a participatory urban planning project in Bam/Iran, conducted by UNICEF, and had experience of using both interviews and questionnaires (Rismanchian, Rismanchian, 2007). In this regard, a tendency was found among participants to say one thing and do another, which is supported by the literature as well (Bell, Montarzino & Travlou, 2006, Rismanchian, Rismanchian, 2007). Also, a serious problem with interviews and questionnaires was found in the case of Bam, which is 'the low expectations' of participants from their surrounding built environment and neighbourhoods as a result of living continuously in poor conditions or not getting involved in any participatory projects. Actually, the author realised that in many cases people need to be informed of their civic rights in the first place before getting involved in any project or even be trained as to how they may use an urban space, a task which can also be accomplished with more participatory projects and workshops simultaneously (Rismanchian, Rismanchian, 2007). But since the aim of this research was not focusing on these aspects, it was decided to not apply these methods in the research.

In addition to the methodological problems with people participating mentioned above, one of the main obstacles of doing field work in Tehran is that to have a participatory project, it would be better for the researcher to have an authoritative sponsorship, since firstly people might not trust the project and secondly, if reported, the police is allowed to investigate the project and ask where the data would be used. Since the author could not find a sponsor for the field work, and the data was supposed to be used in the UK, it was decided to focus on the other alternatives. Another obstacle with conducting fieldworks in Tehran is that apart from the historical and tourist areas, taking photos and recording public spaces are not allowed unless they are sponsored by an authority such as the national television, since, in many cases, people's faces, especially women and children, could be recorded as well as the location of banks or police stations, which raises security issues[28].

[28] In fact the author was not aware of this fact until he got caught by the police, and had to delete many photos and all the videos.

Despite all of these limitations, many alternatives were found in the literature and adopted for the research. In the following sections, the way this research adopted behaviour mapping and site observation techniques from the literature and how they were modified before applying them are discussed.

4.4.2. **Observational Methods**

Observational methods are one of the main methods of data collection in research that deals with how people use a space. To take information on physical activities in specific spaces where environmental features can also be considered, some authors have proposed the use of site observation. Observational methods allow researchers to categorise physical activities and behaviours into distinct classes for further quantitative and qualitative analysis, and identify the type, pattern and frequency of activities seen – as well as when, where, and with whom they occur. (Suminski et al., 2007)

Regardless of the advantages of observational methods in capturing people's activities as they happen in the observation setting, some points need to be considered in conducting the methods. These methods require considerable time to record observational data. However, most plans need to take place within a short timeframe. Another point is that behavioural methods are frequently perceived as being too difficult and complicated to utilise, and in many cases better graphic methods are needed to translate the data into a spatial form that can be utilised in the planning process (Francis, 1984).

This research conducted two types of observational methods including site observation and behaviour mapping. The aim of behaviour mapping was to record the activities with a specific pre-developed method, the 'block walk method', for further objective and quantitative analysis, whereas the site observation was conducted to record the activities with notes, sketches, photos and narratives to facilitate further subjective interpretations.

4.4.3. **Behaviour mapping**

In observing a city, moving elements and especially the people and their activities are as important as the stationary physical part. We are not simply the 'observer' of these activities but a part of the whole scenario, on the stage with other participants. Most of the times our perception of the city is not sustained; but it is rather fragmented, partial, and mixed with other

concerns (Lynch, 1960). Despite of the fragmented perception of the city which is the nature of observing the cities, observational methods and specially behaviour mapping is commonly used in understanding how the cities work.

Behaviour mapping can be defined as an objective observational method for measuring actual use of space, and to study the pattern of behaviours and physical activities in a given space, with the purpose of improving the quality of relations between people and the built environment. The key factor in conducting behaviour mapping is that all the targeted data should be observed simultaneously and coded at precisely the same site location (Moore, Cosco, 2010).

In behaviour mapping, the study site does not need to cover the whole site since it is usually not possible. Rather, it can only cover those areas accessible to users that can be used by them. The behaviour setting should be identified clearly by boundaries such as the 'lines on the ground' of physical components in the built environment, such as pathways, sidewalks, vegetation and similar elements. A map of the behaviour setting is also needed to show both the amount and type of behaviour compared with activity associated with built environment components. In cases whereby the aim of the research is to measure the relative use of space or to discover the pattern behind the activities in a space, observation sessions should be conducted during assumed on-peak periods. The round of the observations usually is defined by the resources available to conduct them, such as the number of observers and the number of the sites to be observed. However, it should manage to record the pattern of behaviours at the end of the observations successfully enough for further analysis. It also should consider some obligatory issues such as climate, weekends, festivals, or holidays. In order to protect the behaviour study from such threats, the observation schedule should take place in as tight a timeframe as possible. Behaviour mapping has the potential to overcome the limitations by having an empirically established observation method, applied with a consistent approach for all the cases (Moore, Cosco, 2010).

4.4.3.1. **Conducting the pilot studies for behaviour mapping**

After reviewing the literature, two pilot studies were conducted; one in Edinburgh and the other one in Tehran. The pilot study in Edinburgh focused on the task of behaviour mapping itself, since the author had no experience of behaviour mapping before, and the pilot study in

Tehran focused on modifying the 'block walk method' specifically for the case of this research. Before conducting the pilot study in Edinburgh Dr Hazreena Hussein[29] was consulted and the researcher was informed about her experiences of conducting observational methods and the probable difficulties in applying them in the research. There was also a training session in the Openspace Research Centre[30] regarding mapping the streets, activities and the built environment components that the author participated in. Keeping the consistency in the observational method was one of the key points the researcher learned throughout the consultations.

In Edinburgh, Bristo Square – near the Edinburgh College of Art – has been mapped briefly just to understand the nature of behaviour mapping. The reason for choosing Bristo Square is that this place had been already mapped[31] (Golicnik, 2004) and the researcher could learn from a previously completed work. The outcome of this pilot study included several questions and obstacles, which were discussed with supervisors.

Afterwards, a pilot study was conducted in Tehran that focused more on the block walk method and its modifications to the case of this research. Based on the literature review, an initial database, including different types of activities, was provided and few segments of streets in the deteriorating area were randomly selected and observed three times a day. The outcome of this pilot study was to eliminate the rush hours and the school-closing times from observations since not only the task of observation was too difficult to conduct during busy times, but also the data would be abnormal as a result of a large number of people in the street for a short period of time. Also, the classification of activities and the format of the database were changed and became more comprehensive, including more activities and items. The method of observation has also been modified after the pilot study. With regards to this, during the pilot study the researcher observed segments from one point and faced lots of problems in mapping the activities in the street. As a result the 'block walk method' was adapted from the literature, re-planned to apply to this research, and was then followed.

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[29] Dr Hazreena Hussein is a graduate from the Edinburgh College of Art and applied observational methods in her work.

[30] By Dr Affonso Zuin and Dr Susana Alves

[31] By Dr Barbara Golicnic is graduated from the Edinburgh College of Art and undertook observation and behavioural mapping as one of her research methods.

4.4.3.2. **Behaviour mapping by using block walk method**

Behaviour mapping is mostly used in the literature to observe widened public open spaces such as parks, plazas, and urban squares, in which the observer could control the behaviour setting mostly from one observation point. This research has found few studies in which the researchers conducted behaviour mapping for the sidewalks and streets. Among them, many of the researchers tried to record pedestrian movement as a mode of transportation by counting them rather than recording their activities, which is in the interest of this research. Thus, this research had to adapt the methods in the literature based on the main purposes of conducting behaviour mapping, which is capturing the variety of activities in the streets.

Suminski et al (2006) conducted a method called the 'block walk method' in order to observe behaviours in sidewalks. Although their main purpose was to examine the pedestrian movement from a transportation point of view, this research adopted the method and modified it for its benefit.

In this method each street is divided into different segments for observation. The segments do not necessarily cover the whole street but they capture the most important parts of the street in which most activities are happening. In their studies they selected five 305-metre segments and observed them on four weekdays and two days during the weekend. Each segment was observed for ten minutes on six different days (weekdays and weekends). The observation boundaries were defined as a line extending to the left and right of the observer's shoulders, linearly and perpendicularly from the observer's plane of motion, then the observer recorded selected physical activities that occurred in the observation fields. A physical activity was only recorded if the observer crossed a parallel plane of motion to an observed physical activity (Suminski, Petosa & Stevens, 2006).

4.4.3.3. **Modifying the block walk method for this research**

The purpose of Suminski's research was examination transportation routes, but this research focuses on people's activities in the streets including passengers, shopkeepers, vendors etc. therefore, the research needed to modify the method as follows before applying it.

At the first stage the most integrated and segregated lines of the case study were extracted from the Tehran axial map. By having an initial site observation from the area, it was

confirmed that, as anticipated, there are more activities happening in the most integrated streets, thus the most locally integrated streets were extracted from the axial map [Figure 4-13].

Figure 4-13: The most locally integrated streets of the case study area

i. Selecting the streets: Five locally integrated streets were selected for in-depth observation, which are shown with arrows in Figure 4-13. At the next stage, another round of site observation was conducted to check the street life in the selected streets. Among the locally integrated lines one of them, the one shown with double arrow, was eliminated from further investigation since this route use to be a seasonal river, which unfortunately has been recently changed into a channel and transformed into a wide artery for transportation purposes. This transformation made the line highly integrated but with almost no street life since it was actually transformed into an artery, rather than a green street or pedestrian mall[32]. The seasonal river is shown in blue in Figure 4-14.

ii. Observation periods: After selecting the four streets, they were observed several times on weekdays and weekends without recording any activities, just to capture the overall atmosphere of the streets and identify the highly used segments for in-depth

[32] This is a typical car-orientated planning regime which destroys high potentials of the city for having a 'green network'. The result is ecological problems as well as a not people-friendly city which delivers more hazardous to people's daily life rather than facilitates that. This research hopes to contribute positively to such system.

observations. The observations were conducted at late summer and early autumn when the weather was mainly moderate. There was no rain or other unexpected issues that affect people's routine life style. The first result found in the above task was that there are considerably less activities happening on the weekends in the streets since it is habitual for people to go to the nature areas, their private gardens in the outskirts of the city, or to the main urban parks to engage more with nature and find relief from daily work stress, therefore it was decided to conduct the behaviour mapping on weekdays. The researcher observed each segment three times a day; at late morning, afternoon, and evening, excluding the rush hours in the early mornings and the late evenings, since pedestrian movement at these times is considered more as a mode of transportation. Also, during these peak times streets become so busy that one observer cannot map the activities at all.

iii. Observation settings: At the next stage, six segments in each of the four streets were selected for further analysis. The length of each segment was under five minutes' walking distance and roughly between 230 and 250 metres, depending on the segment. It is worth noting that normally one can walk more than 250 metres in five minutes, but considering that the researcher had to observe the activities, count people who were involved in the activity, and record everything at the same time, the lengths of the segments were optimised. Each segment included just one side of the street from the sidewall of the street to the slow drive lane including the frontage, sidewalk, verge, hedge and vegetations, driveways and slow drive lane. The width of the setting varies between two to eight metres depending on the quality of the segments.

iv. Recording method: A recording method was developed before conducting the behaviour mapping. With regards to this, a high-resolution map of the area, at a scale of 1:2000, was provided from the Tehran GIS Centre in which the blocks adjacent to the streets are shown at the parcel scale [Figure 4-14]. Another map from each segment was produced in AutoCAD by the researcher to enlarge the segments to make more space for recording the notes, probable sketches and so on [Figure 5-24 to Figure 5-27]. The recording method included the maps, a clipboard and a pencil. No video, image or voice recording device was used during the behaviour mapping,

although at the end of each time of behaviour mapping the segments were photographed[33]. All the notes were taken in Farsi[34] rather than in English.

v. Preparation tasks: Before conducting the behaviour mapping the researcher visited the sites several times. Since the aim of the research was to study the street life and identify different activities happening in the most integrated streets, not to study the relationship between the built environment and the behaviours, the streetscape elements were not recorded completely. However, the shops, whether they are local or regional businesses, and the main streetscape components, such as urban furniture, which have been used by people or the shops, were recorded. The locations of vendors were also mapped, although they might change their location in different conditions.

Figure 4-14: An example of the map provided for observation, the seasonal river is shown here in blue

vi. Planning the block walk method: The researcher planned the method of observation and behaviour mapping as follows. Throughout the non-recording site observations,

[33] It is noticeable that photography, voice and narrative recording are used in the 'sit observation' conducted after the behaviour mapping as another observational method.

[34] Farsi is the author's first language.

the activities frequently happening were identified. Later on, based on the site observations, the pilot studies and the literature review; a database including set of activities was provided. The activities were dichotomised into movement activities such as walking and non-movement activities. The walking activities were also dichotomised into walking as a mode of transportation and as a recreational activity such as walking and shopping. With regards to this, the recorded activities included group walking, passing by, shopping, sitting, standing, sleeping, cycling, eating, local retailers, regional retailers, vendors, kiosks, and motorcycles, and the activities were recorded separately based on gender. Considering that the streets were not child-friendly at all, the only recorded child activity was 'passing by'. However, children's activities were considered, but in the 'site observation' method which is explained in later sections. In each round of observation the researcher walked from one end of the segment to the other recording the activities. In each round, one segment was surveyed four times and observed almost for twenty minutes, five minutes for each survey[35]. The researcher recorded only the pedestrians who were walking from the opposite side, although all other non-movement activities were recorded as the researcher passed by. The number of people involved in each activity was also counted as many times as possible. For each segment, every activity was recorded once during the four observations, unless the nature of the activity changed. Later on, all of the collected data was put into Excel and SPSS software for further analysis.

4.4.4. **Site observation**

Although behaviour mapping is a useful method in studying activities in public open spaces, it has some weaknesses, which can be strengthened by applying other methods. For instance, in the case of this research, behaviour mapping could capture the activities happening in the deteriorating areas, but does not necessarily give a general idea of what is happening in the streets of Tehran. Also, since behaviour mapping needs to be conducted very carefully and consistently, and in some cases is time consuming and difficult, it might not be possible to observe different aspects of the social life. Moreover, the research is interested in the activities that are not happening in the deteriorating areas, meaning that there is a possibility that some

[35] Each round included four instances of going up and down the segment.

activities could be happening in the deteriorating areas, but they are not, and vice versa. In this regard, to strengthen the methodology and get an insight into the deteriorating areas, several rounds of site observation were conducted from both the deteriorating and non-deteriorating areas. This approach could give the research a strong insight into the street life and activities happening in the same research context by people from the same culture and religion. Additionally, site observation allows the researcher to move freely in the site without being noticed and observe activities for a longer time to get more notes and data.

With regards to this, Whyte (1980) conducted an in-depth site observation to discover how people use public open spaces. In his work Whyte has observed several urban plazas, street life, children activities and captured people's life style mainly by camera and photography. In his research, The Street Life Project, he conducted direct observation in New York City parks for a long term. He explains his method as followed "*We started by studying how people use plazas. We mounted time-lapse cameras overlooking the plazas and recorded daily patterns. We talked to people to find where they came from, where they worked, how frequently they used the place and what they thought of it. But, mostly, we watched people to see what they did*" (Whyte, 1980, p16). At that time, this method had not been used to any great extent in the U.S. city and there was much concern over urban crowding, but this project achieved some interesting outcomes. The first thing that has been revealed was 'the lack of crowding', as he says, in many of these areas. His main finding can be summarized in one key sentence: what attract people most, it would appear, are other people, as he says in his book.

Marcus et al. (1998) also applied the same method to study people's lifestyles in the streets, urban plazas, and neighbourhood parks. Gehl (2006) also carried out the same method and delivered a broad classification for people's lives, especially in the streets including necessary, optional and social activities. The process of site observation has been conducted in this research as follows:

i. Street selection for site observation: For conducting the site observation, the five most locally integrated streets in the deteriorating area were selected[36] [Figure 4-15]. Apart from the locally integrated street of the deteriorating area, some other streets in the

[36] Street 01 is the Namjoo Street, 02 is the Madani Street, 03 the Sabalan Street, 04 is the seasonal river and 05 is the Janbazan Street

non-deteriorating areas were also selected for site observation to obtain a better idea of the Tehran street life.

Figure 4-15: Five locally integrated streets in district 07 and 08

With regards to this, four locally integrated streets of the non-deteriorating area, the control neighbourhood of this research, were selected which are pointed out with numbers and arrows in Figure 4-16. One of the streets, number 04 – also shown with double arrows – is particularly interesting since it is a boulevard, the Keshavarz Street, with a greened pedestrian route in the middle of it which has six rows of trees. In fact, it was originally a recreational pedestrian street which has been transformed into a busy street [Figure 4-17 and Figure 6-24].

Figure 4-16: The locally integrated streets of the control neighbourhood, Tehran District 06

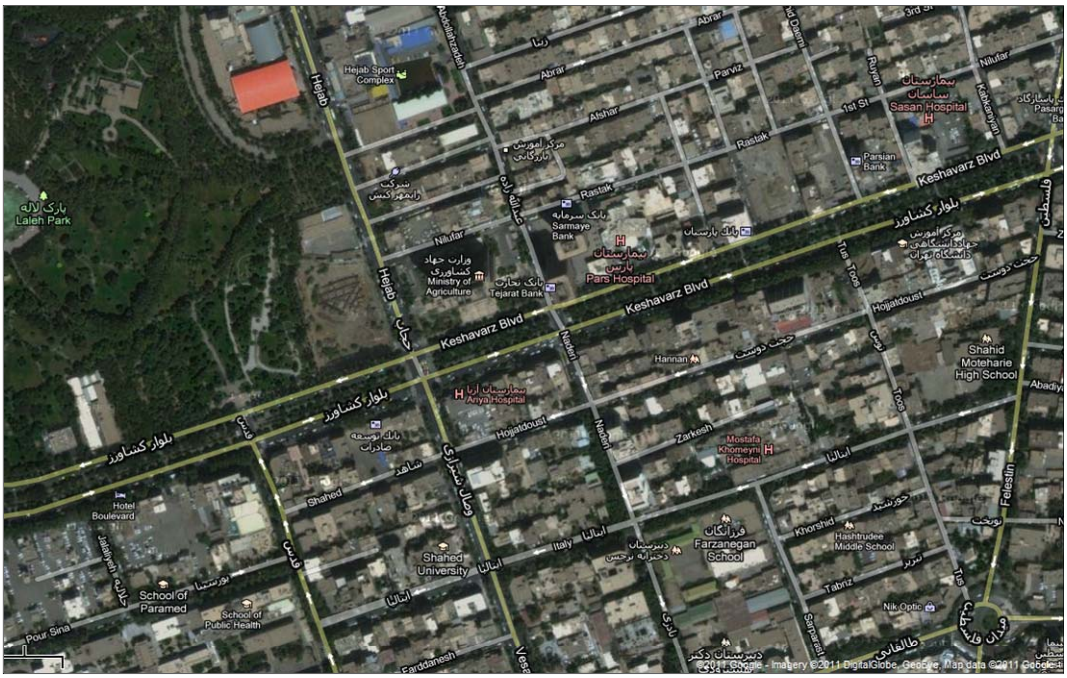

Figure 4-17: The Keshavarz Street from above, by Google Map 2011

Moreover, in the vicinity of the most locally integrated street of the deteriorating area, Namjoo Street, shown as number 01 in Figure 4-15, there is a neighbourhood park, Namjoo Park, and the street itself ends to a small greend square, Namjoo Square, which were both selected for site observation [Figure 4-18].

Figure 4-18: The location of the park and the square next to the integrated line in the deteriorating area

Another place in the case study was also selected for observation; Nabovat Square – found in street number 05 in Figure 4-15 – which has dimensions of almost 250m by 50m, and is surrounded by driving lanes, but interestingly it was used frequently by residents [Figure 4-19].

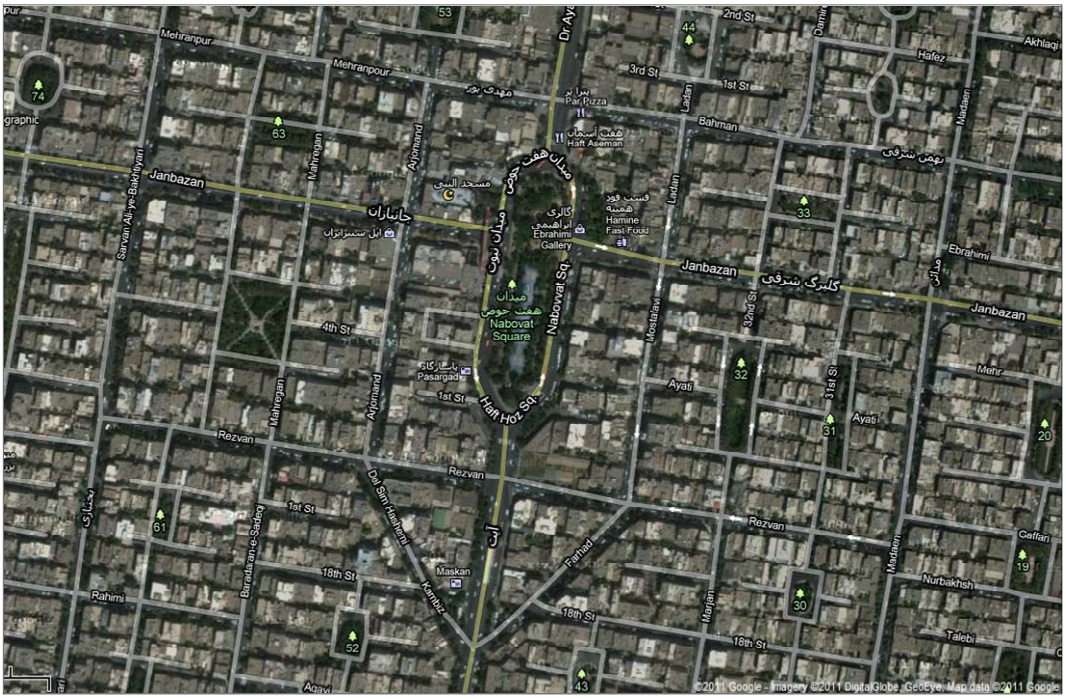

Figure 4-19: The Nabovat Square, Google map 2011

Additionally a recently developed pedestrian street, 15th of Khordad Street, next to the Tehran Grand Bazaar was selected for observation [Figure 4-20]. The selection of the boulevard, and the pedestrian mall next to the bazaar, allows the research to investigate the activities that could be happening in the pedestrian-friendly streets in the same research context. The selection of the small parks and squares allows the research to observe the social and recreational activities happening not necessarily in the streets, but next to them. The observation of such a selection could give the research an in-depth insight into the social life, which can facilitate the data interpretation and recommendations.

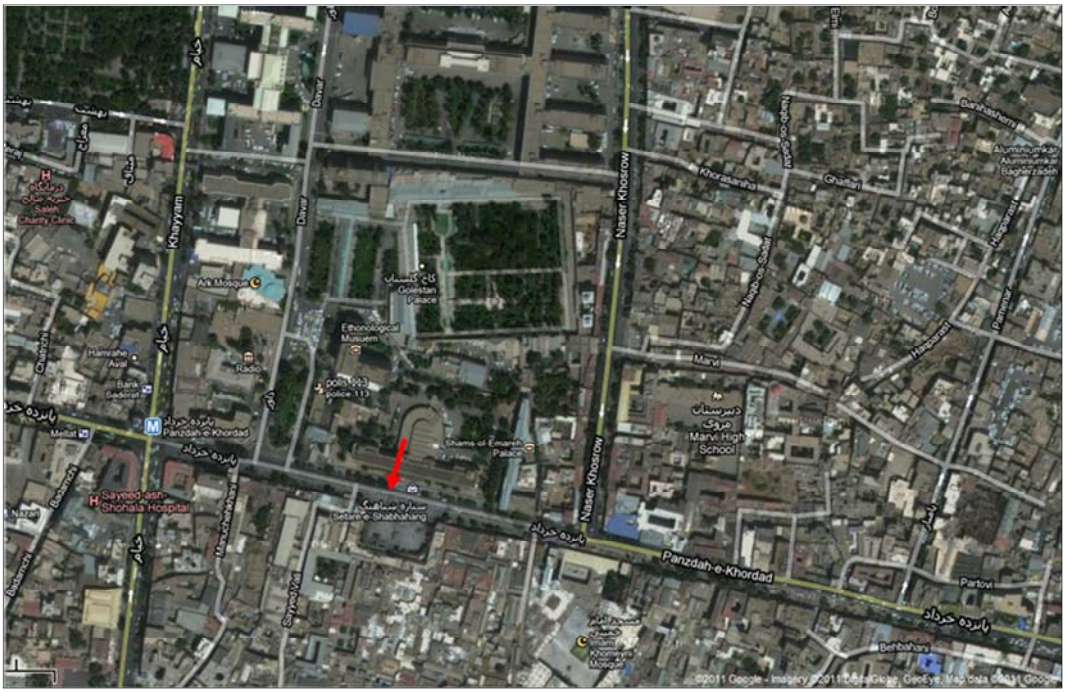

Figure 4-20: The 15th of Khordad Street, Google Map 2011

ii. Recording instruments: In order to record the data during the site observation, mainly voice recordings and photographs were taken on a mobile phone. Also, narratives, notes and a few sketches were recorded on paper.

4.4.5. **Studying the outcome of the observations using factor analysis**

Factor analysis can identify the underlying factors or the pattern behind a set of observed data. It is also a method to screen, summarise or sample the collected variables, which are applicable for analysing the collected data, by observational methods in this research.

Factor analysis is a variety of statistical methods and techniques and its common objective is to represent a set of variables in a smaller number of theoretical or assumed variables. Factor analysis can help researchers to examine and understand how underlying constructs influence the responses on a number of observed variables. In fact, in many cases the researcher has no idea about how many underlying aspects there were for the given data. In this case, factor analysis can be used as a practical method for capturing the minimum number of hypothetical factors that can explain the observed data. With regards to this, it is mostly used as a means for exploring the data for possible data reduction. This form of use is exploratory, which is being heavily used in social sciences research such as this (Kim, Mueller, 1978).

4.4.5.1. **Analysis method**

One of the interests of this research is the Tehran 'street life' in order to highlight the differences between 'artery' and 'thoroughfare' with 'streets'. In the literature, the street life is divided into three categories of necessary, optional, and social activities; each of them with a specific example (Gehl, 2006). Given that the research context is fundamentally different from the case studies in the literature, and the reviewed literature mainly considers western countries, the researcher needed to identify the pattern of street life happening in the streets of Tehran separately. With regards to this, two observational methods, one quantitative and one qualitative, are applied in which 19 activities based on gender are recorded by conducting a behaviour mapping technique. In order to analyse the collected data, a method was needed to help the researcher to understand the pattern underlying the 19 activities. With regards to this, the researcher applied factor analysis to capture the fundamental pattern behind the observed activities. Also the researcher could subjectively categorise the observed activities as necessary, optional and social, following the literature. However, using factor analysis could help to avoid any subjective approach and have the same classification with an objective method. In order to conduct factor analysis, SPSS software was applied.

4.5. **Developing a transformability index, a link between syntax and society**

This research applied space syntax to study the spatial structure of the city, as well as the deteriorating areas, in relation to the entire urban system. It also applied the observational methods to study the Tehran street life to consider it in the recommendations. However, it seems that there is a gap between the holistic approach of space syntax and the fine approach of the observational methods and social aspects of the neighbourhoods. In order to fill this gap, an index called the 'transformability index' was developed, based on the available data from the neighbourhood of the case study, to monitor the route filtering system and the planning approach. Karimi et al (2007) also applied the same index to control the route filtering system, but their method in developing such an index is not exactly the same as the one in this research.

The transformability index is a ranking system that gives the redevelopment potential for each parcel or land plot based on its existing conditions. Technically, this index shows how easy it is to intervene in an area such as a parcel, considering that different criteria affect that

particular parcel such as land price, building quality, building height, age of building, material, occupation and land use (Karimi et al., 2007). The transformability index helps optimise the cost, both financially and socially, of any physical intervention into an area. The more data is available, the finer transformability index can be developed. In fact, one the limitations of developing such an index for this research was the limited amount of available data. However, it was decided to develop such an index based on the available data to precede the research, although it is obvious that the outcome of this method could be different if more data was available. This index helps consider people's lives in the planning stage and acts as a middle-scale method, filling the gap between the route filtering system and the social aspects when developing the recommendations.

In order to develop such an index, a map at a parcel scale was provided from the case study, in which each property is carefully shown with its boundary and attributes. The available data for each parcel including the indicators and sub-indicators are shown in Figure 4-21. These indicators and sub-indicators highlight the social aspect of the neighbourhoods and represent the condition of each parcel in the area[37], and can take the socio-economic condition of the people living in the area into account during the planning process. Data of a different nature, such as the level of the education of the tenants, their income and etc. can be added to the database to develop the method on a finer scale. In order to develop a transformability index, the sub-indicators have been scored through an AHP process, and afterwards, the main indicators themselves are also weighted by the same process.

[37] 'No Quality' in the building quality section and 'Abandoned' in the building age section represent public open spaces e.g. parks.

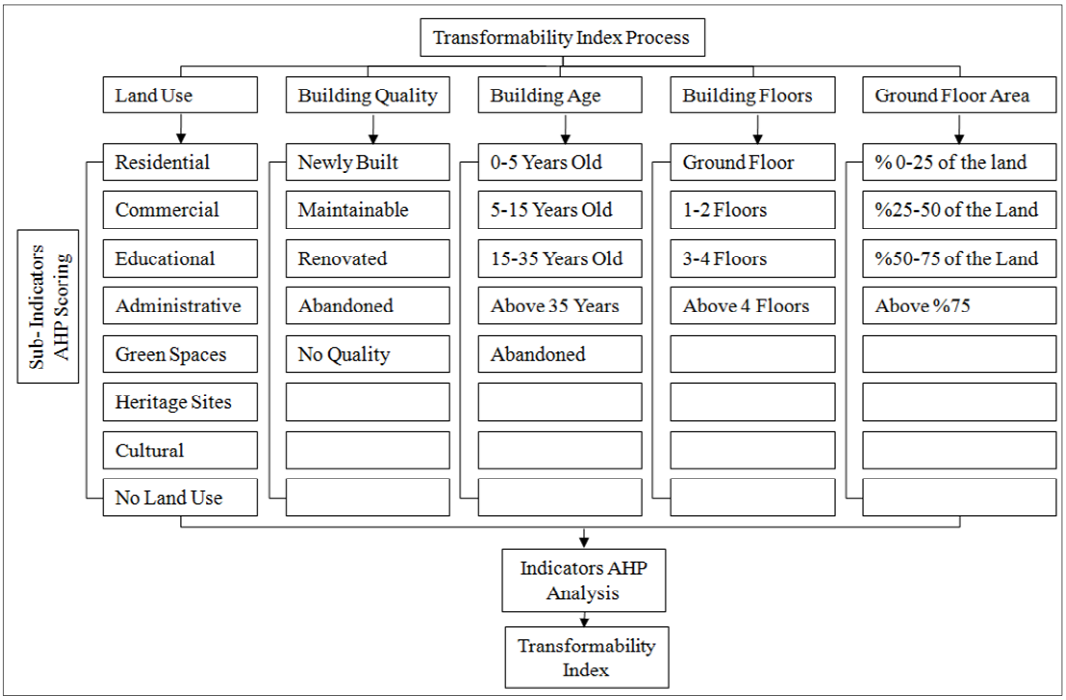

Figure 4-21: The transformability index indicators

Mokhtarzade (2011) in her study of the relationship between the sustainability indicators and the quality of the neighbourhoods in the deteriorating areas also applied AHP analysis as her main research method in order to score each of the indicators and sub-indicators at the parcel scale. For developing the transformability index in this research, considering the similarities of both researches in terms of their subject areas - which are about urban regeneration - and the research context - which is Iran in the two studies - this research also applies the same indicators and scoring system that Mokhtarzade has proposed. In the following section the method by which she developed this scoring system and the rating values is discussed. In scoring the indicators and sub-indicators, each pair of factors should be compared two-by-two according to the objective of the research, and a comparison between the judgments should be controlled, ensuring they are less than 0.01 ((Saaty, 1980) cited from (Mokhtarzade, 2011)). With regards to this, the comparisons are made based on Saaty's rating scale, as featured in Table 4, (Mokhtarzade, 2011). In this regard the scoring tables are shown here.

Table 4: Saaty Rating Scale, ((Saaty, 1980) cited from (Mokhtarzade, 2011))

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective
3	Somewhat more important	Experience and judgement slightly favour one over the other.
5	Much more important	Experience and judgement strongly favour one over the other.
7	Very much more important	Experience and judgement very strongly favour one over the other. Its importance is demonstrated in practice.
9	Absolutely more important.	The evidence favouring one over the other is of the highest possible validity.
2,4,6,8	Intermediate values	When compromise is needed

Table 5: The building quality sub-indicators, (Mokhtarzade, 2011)

The Building Quality Sub-Indicators	Abandoned	No Quality	Renovated	Maintainable	Newly Built	Judgement Comparison	Final Score
Abandoned	1	3	5	7	8	0.07	0.5
No Quality	0.33	1	4	5	6		0.28
Renovated	0.2	0.25	1	3	5		0.13
Maintainable	0.14	0.2	0.33	1	3		0.06
Newly Built	0.13	0.17	0.2	0.33	1		0.03
							1

Table 6: The building age sub-indicators, (Mokhtarzade, 2011)

The Building Age Sub-Indicators	Abandoned	Over 35 Years Old	35-15 Years Old	15-5 Year Old	5-0 Years Old	Judgement Comparison	Final Score
Abandoned	1	3	5	6	8	0.07	0.5
Over 35 Years Old	0.33	1	3	4	6		0.25
35-15 Years Old	0.2	0.33	1	3	5		0.14
15-5 Year Old	0.17	0.25	0.33	1	4		0.08
5-0 Years Old	0.12	0.17	0.2	0.25	1		0.03
							1

Table 7: The building ground floor area sub-indicators, (Mokhtarzade, 2011)

The Ground Floor Area Sub-Indicators	%0-25	%25-50	%50-75	Above %75	Judgement Comparison	Final Score
%0-25	1	5	6	7	0.08	0.62
%25-50	0.2	1	3	5		0.21
%50-75	0.17	0.33	1	3		0.11
Above %75	0.14	0.2	0.33	1		0.06
						1

Table 8: The land use sub-indicators, (Mokhtarzade, 2011)

The Land Use Sub-Indicators	No Land Use	Green Space	Residential	Commercial	Educational	Administrative	Cultural	Historical	Judgement Comparison	Final Score
No Land Use	1	3	4	6	7	8	9	9	0.08	0.38
Green Space	0.33	1	3	4	6	7	7	8		0.24
Residential	0.25	0.33	1	3	5	5	6	7		0.15
Commercial	0.16	0.25	0.33	1	3	4	5	5		0.09
Educational	0.14	0.16	0.2	0.33	1	3	4	4		0.06
Administrative	0.12	0.14	0.2	0.25	0.33	1	3	3		0.037
Cultural	0.11	0.14	0.16	0.2	0.25	0.33	1	2		0.024
Historical	0.11	0.12	0.14	0.2	0.25	0.33	0.5	1		0.019
										1

Table 9: The building floor sub-indicators, (Mokhtarzade, 2011)

The Building Floor Sub-Indicators	Ground Floor	1-2 Floors	3-4 Floors	Above 4 Floors	Judgement Comparison	Final Score
Ground Floor	1	5	6	7	0.08	0.62
1-2 Floors	0.2	1	3	5		0.21
3-4 Floors	0.17	0.33	1	3		0.11
Above 4 Floors	0.14	0.2	0.33	1		0.06
						1

Table 10: The AHP indicators, (Mokhtarzade, 2011)

AHP	Land Use	Quality	Age	Floor	Ground Floor	Judgement Comparison	Final Score
Land Use	1	2	3	5	7	0.03	0.4276
Quality	0.5	1	2	4	6		0.2745
Age	0.3	0.5	1	3	5		0.1759
Floor	0.2	0.3	0.3	1	3		0.0811
Ground Floor	0.1	0.2	0.2	0.3	1		0.0409
							1

In order to apply the scored indicators, the map of the area at the scale of parcel was weighted based on the scores in which each parcel scored showing how easy it is to be manipulated. The relevant maps are presented at the result section [Figure 5-49].

4.6. **Integration of the methods**

In the above sections the main methods that have been applied in the research in order to investigate the research questions and support the assumption of the research are discussed. However, the integration of the methods in doing so is also important in highlighting the potential application of the developed methods. Figure 4-22 shows how this research applied the methods and combined them in order to highlight the potential application of the developed methods in the deteriorating case of the research.

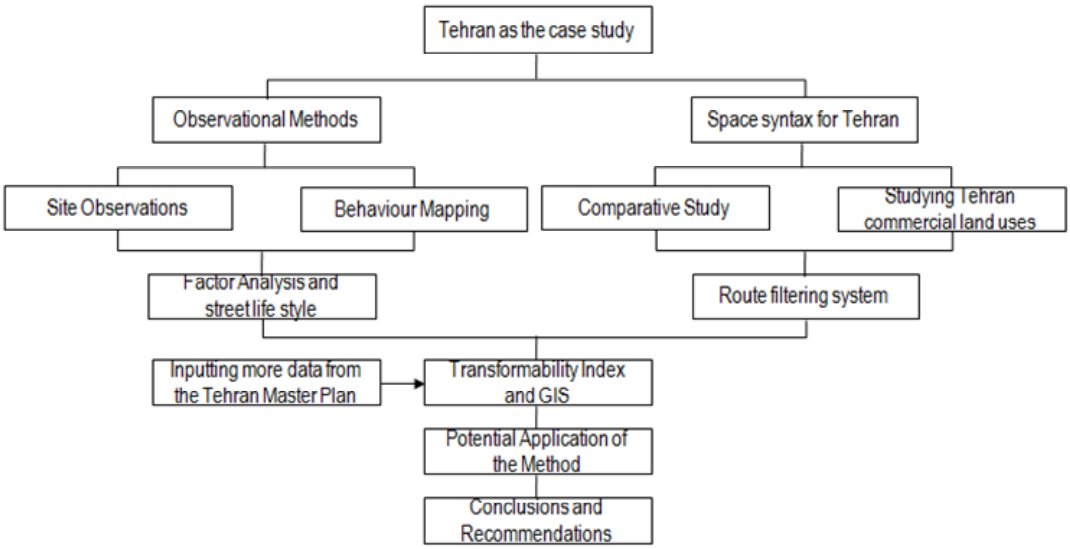

Figure 4-22: The integration of the methods

Figure 4-22 shows that the methodology of the research is divided into two main parts including space syntax for studying the spatial and economic condition of the city, and observational method for studying the social aspect of the streets. The result of applying space syntax is studying the spatial structure of the city and correlating it with the distribution pattern of commercial plots which leads to developing the route filtering system. The result of observational methods leads to identifying different activities in the streets of Tehran. The combination of the results of space syntax and observational method in addition to some supplementary data from the Tehran Master Plan lead to the transformability index and helps in developing the desired design and planning tool this research is looking for.

5. Chapter Five: Results

In this part, the results of applying the abovementioned methods are shown along with the produced maps and tables. Moreover, each map and table is discussed in detail and their validity is supported by the literature.

5.1. Results of the space syntax study

In this section the maps produced by applying space syntax for the case of Tehran are presented. Moreover, the spatial structure and the condition of the deteriorating areas in the entire city are discussed. Also, the spatial isolation of the deteriorating areas is investigated in detail through a comparison between the two cases of this research, including the deteriorating area and the control area. Finally, the accessibility issue of the deteriorating case is discussed and supported by the literature.

In section 4.2, the methods of producing the syntactic maps have been explained. Figure 5-1 to Figure 5-4 show the distribution of global and local integration (R3) in the Tehran axial map. The locations of the deteriorated areas are shown with a black continuous line while the locations of the two case studies, the deteriorating case and the control case, are shown with a blue dashed line. Figure 5-1 and Figure 5-3 show the axial line for the entire city, whereas Figure 5-2 and Figure 5-4 show the axial lines only in the two cases to enlarge the area, and to clarify its spatial structure. The most integrated street of the deteriorated area is shown with an arrow.

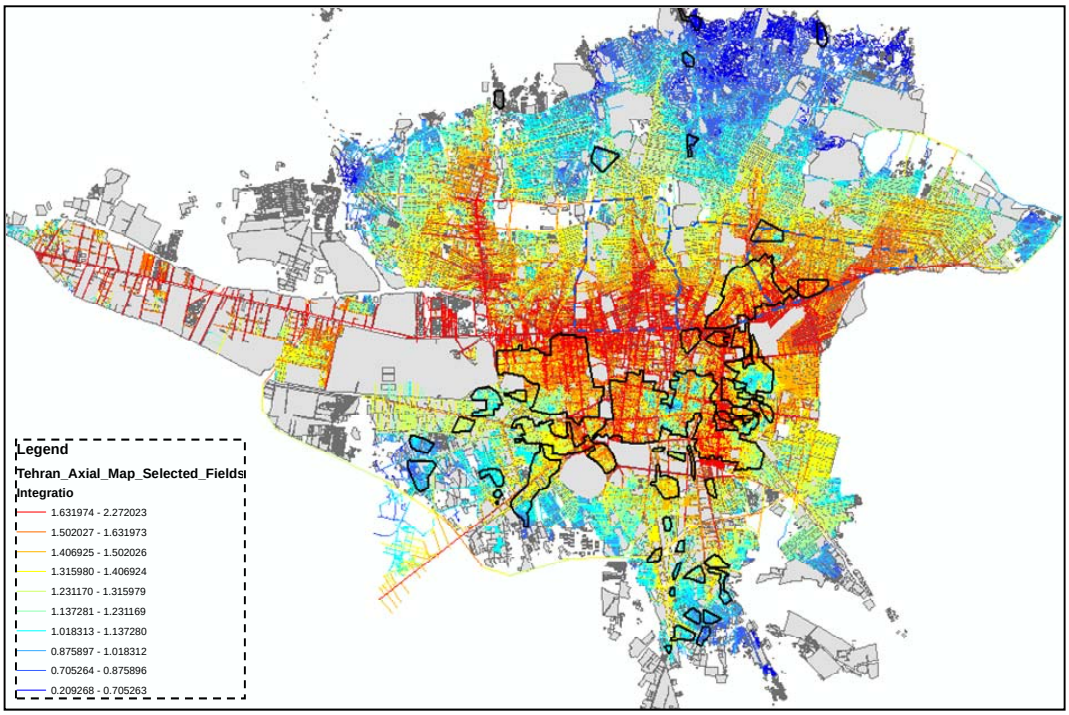

Figure 5-1: The distribution pattern of global integration in the Tehran axial line map

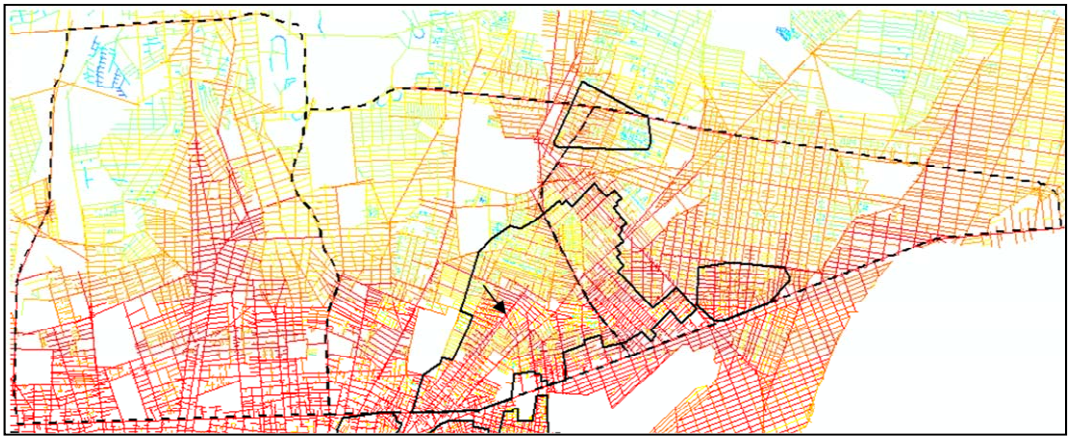

Figure 5-2: A bigger scale axial line map for the two cases study, global integration

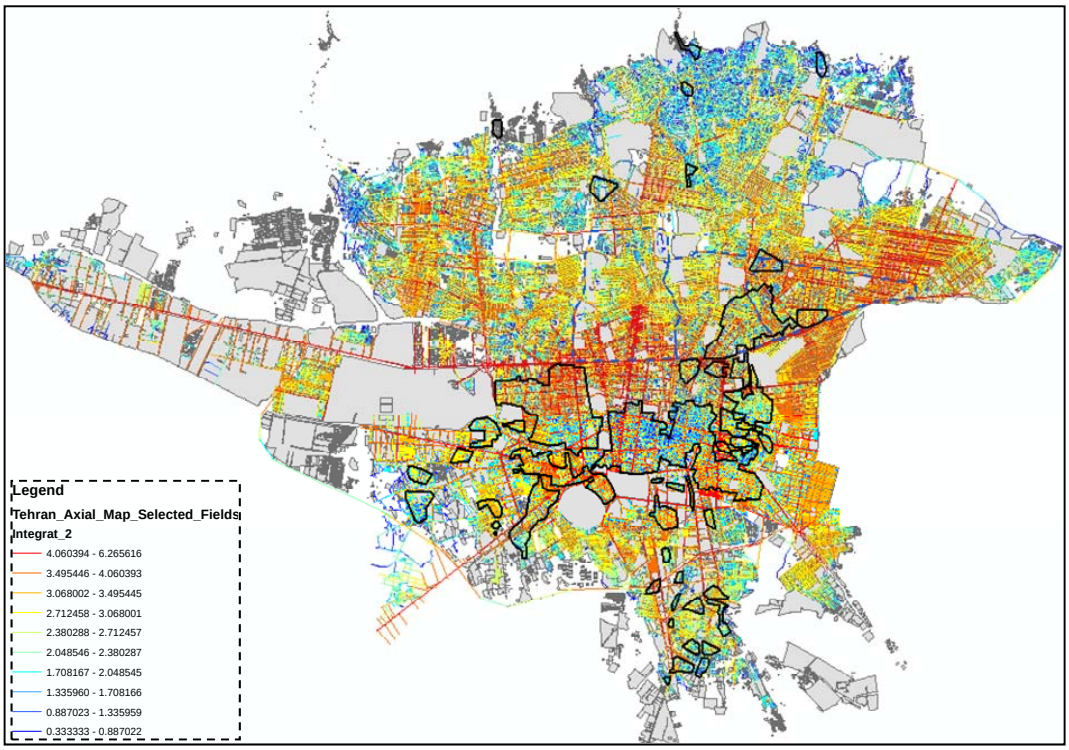

Figure 5-3: The distribution pattern of local integration in the Tehran axial line map

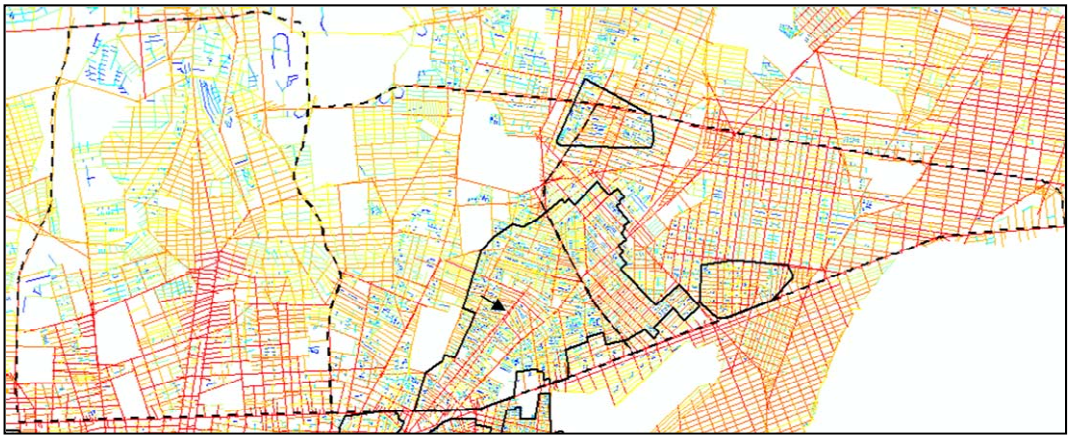

Figure 5-4: A bigger scale axial line map for the two cases study, local integration

5.2. **Results of studying commercial land use vs. syntactic measures**

This study is interested in studying the relationship between the syntactic measures and commercial land use plots in Tehran, to study the potential for making more opportunities for the creation of commercial land uses, and in return attracting more pedestrian movement to the deteriorating areas (Hillier et al., 1993, Hillier, Vaughan, 2007). Before bringing the results of correlating the distribution pattern of the commercial plots and syntactic measures, the maps are overlaid to grab a general idea of how the distribution pattern of the commercial

plots follows the distribution pattern of global and local integration. Figure 5-5 and Figure 5-6 show this pattern for the global integration and Figure 5-7 and Figure 5-8 show the same pattern for the local integration. As can be seen in these figures the distribution pattern of commercial plots follows the locally integrated lines more than the globally integrated lines. The results of statistical analysis and correlating the distribution pattern of the commercial plots and syntactic measures also support this fact.

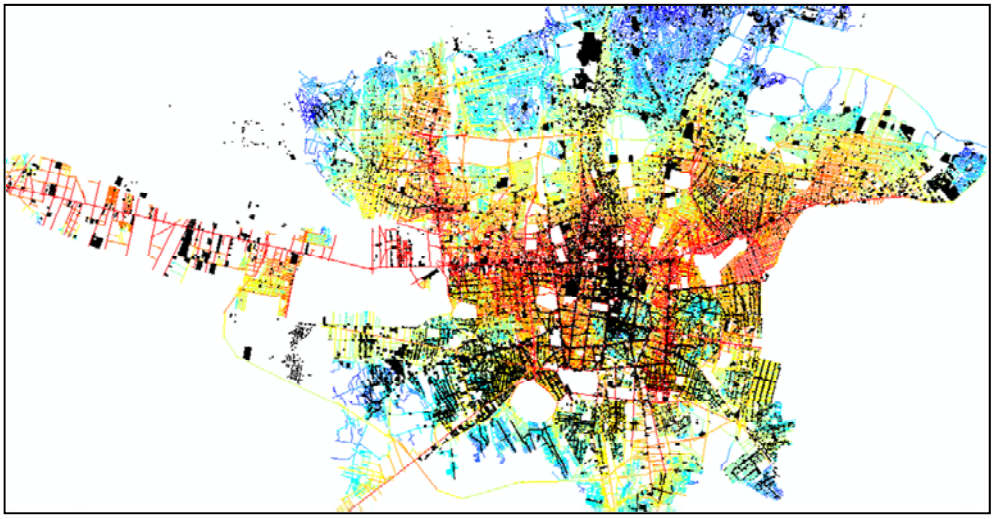

Figure 5-5: Overlaying the commercial plots and global integration

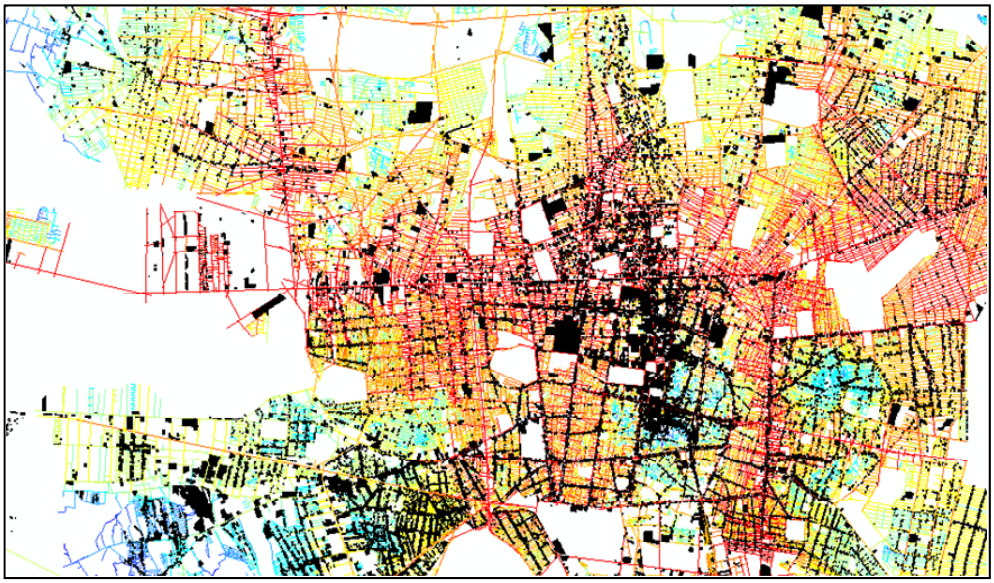

Figure 5-6: Overlaying the commercial plots and global integration, Zoom in

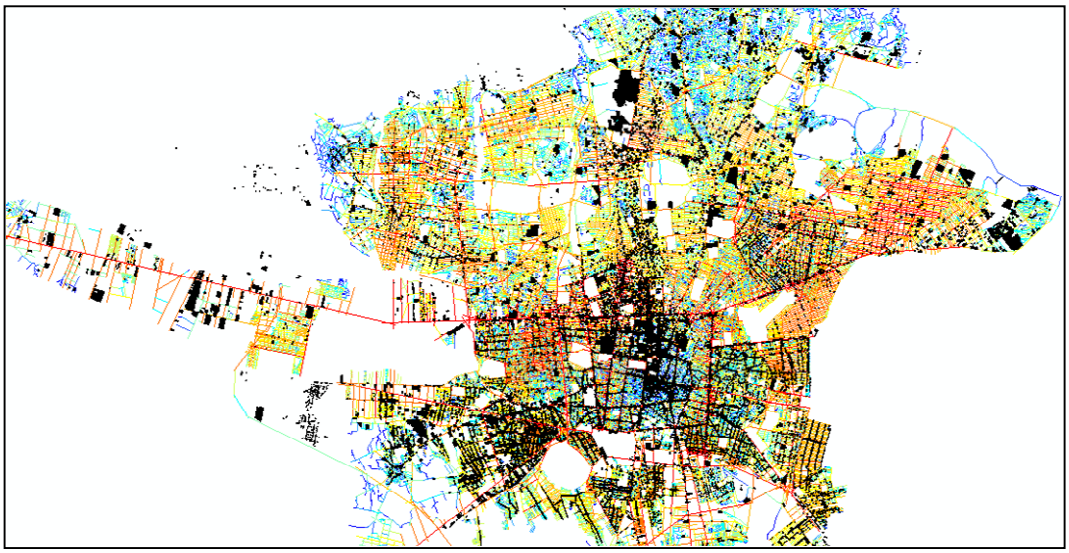

Figure 5-7: Overlaying the commercial plots and local integration

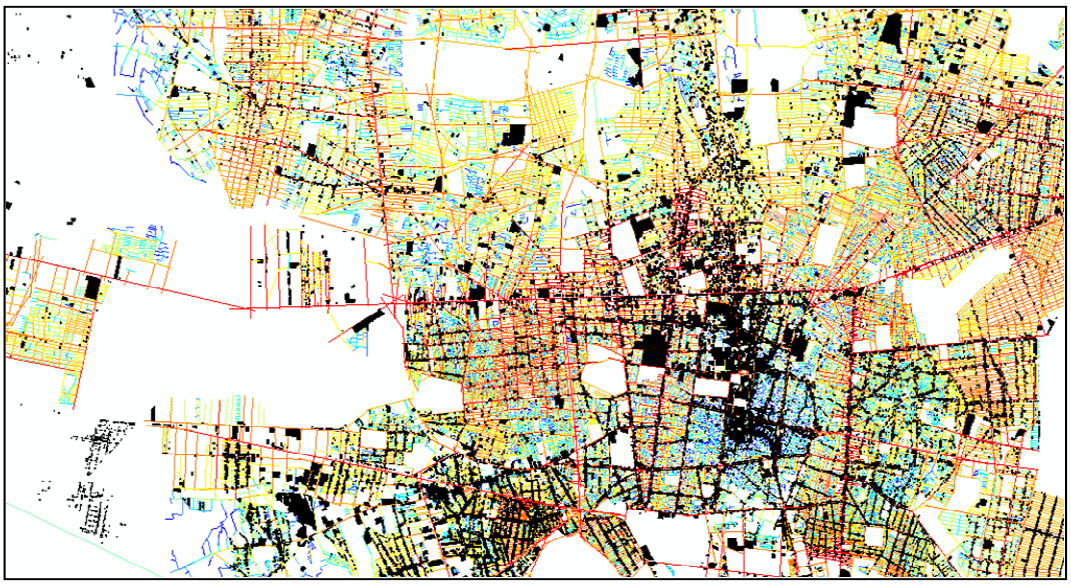

Figure 5-8: Overlaying the commercial plots and local integration, Zoom in

The methods by which the data are modified and the correlations are conducted are mentioned in section 4.2 and 4.2.3 and the results are shown here. The number of the commercial plots based on the base area (180 square metres, which is discussed earlier) is used to conduct the correlations. Before conducting the correlations, the distribution of the data for the number of the commercial plots based on the base area is studied to see whether it has a normal distribution or not. Figure 5-9 shows that despite all the calibrations made in section 4.2.3, the distribution of the data remains abnormal, thus a nonparametric correlation using Spearman's method is chosen for further investigation (Brace, Kemp & Snelgar, 2006).

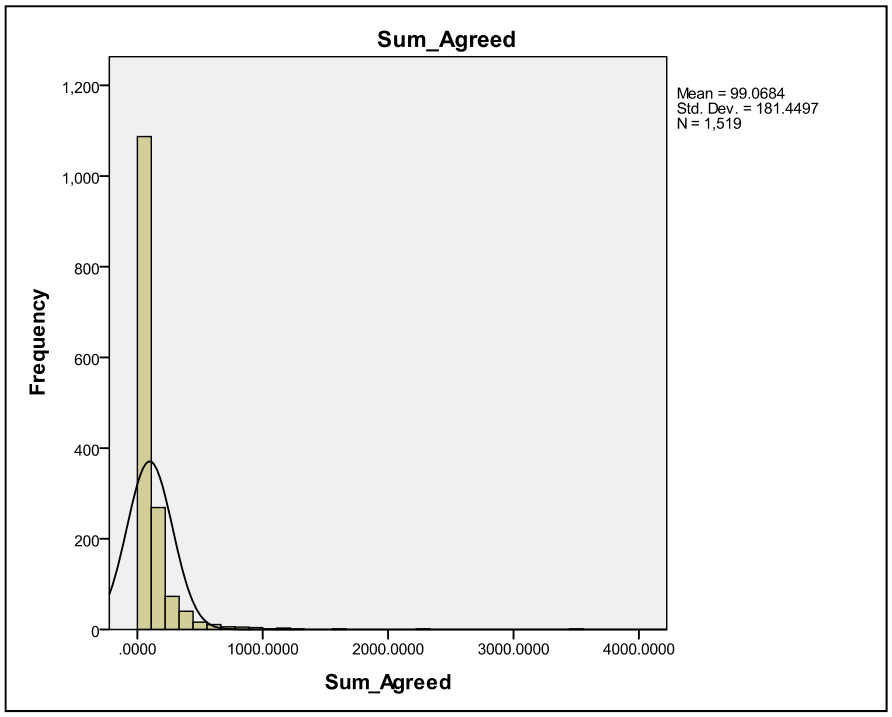

Figure 5-9: The abnormal distribution of the number of the commercial plots[38]

Table 11 shows that there is a significant positive correlation between local integration (R3) and the number of the commercial land use (r_S=0.498, N=1519, p<0.0005, two-tailed). It shows that integration R7 is also significantly correlated with the number of the commercial land use. However, its correlation is less than the local integration (r_S=0.393, N=1519, p<0.0005, two-tailed). Finally, it demonstrates that among different radii of integration, the global integration is less correlated with the number of the commercial land use. However, this correlation is still significant (r_S=0.322, N=1519, p<0.0005, two-tailed).

Table 11: Correlations between integration and the number of commercial land use plot

			Integration R3	Integration Rn	Integration R7
Spearman's rho	Sum Agreed	Correlation Coefficient	.498**	.322**	.393**
		Sig. (2-tailed)	.000	.000	.000
		N	1519	1519	1519

**. Correlation is significant at the 0.01 level (2-tailed).

Table 12 shows that there is also a significant positive correlation between choice (R3) and the number of the commercial land use (r_S=0.376, N=1519, p<0.0005, two-tailed). It also

[38] Sum Agreed here means the number of the commercial plots based on the base-area, 180 square metre

shows that choice R7 is also significantly correlated with the number of the commercial land use however, its correlation is less than choice R3 (r_S=0.344, N=1519, p<0.0005, two-tailed). Finally, it demonstrates that choice Rn is also significantly correlated with the number of the commercial land use, but its correlation is the least in comparison to choice R3 and R7 (r_S=0.181, N=1519, p<0.0005, two-tailed).

Table 12: Correlations between choice and the number of commercial land use plot

			Choice Rn	Choice R3	Choice R7
Spearman's rho	Sum Agreed	Correlation Coefficient	.181**	.376**	.344**
		Sig. (2-tailed)	.000	.000	.000
		N	1519	1519	1519

**. Correlation is significant at the 0.01 level (2-tailed).

The positive correlations shown above help the design and planning tool in predicting urban activities and the more positive the correlations are, the stronger predictor the model would be. With respect to the results of correlations in this research, it should be acknowledged that local and global integration and the values of choice can explain less than 40% of the effective factors in the pattern of the distribution of the commercial land uses and further research is required to fully understand this issue.

5.3. **Result of the comparative study between the Tehran neighbourhoods**

In the previous section the linear maps representing the street network configuration of the city were discussed. In this part, the syntactic measures are compared for the neighbourhoods of Tehran to make it possible to have a comparative study between the city's deteriorating and non-deteriorating areas. The maps produced for conducting a comparative study between Tehran's neighbourhoods are shown in Figure 5-10 to Figure 5-22, in which red represents a high value of the measure and blue represents a low value of the same measure. The process of producing these maps is discussed in section 4.2.4. For each measure, the comparative table is also presented and discussed. Figure 5-10 and Figure 5-11 show the comparative study for the global integration in Tehran's neighbourhoods.

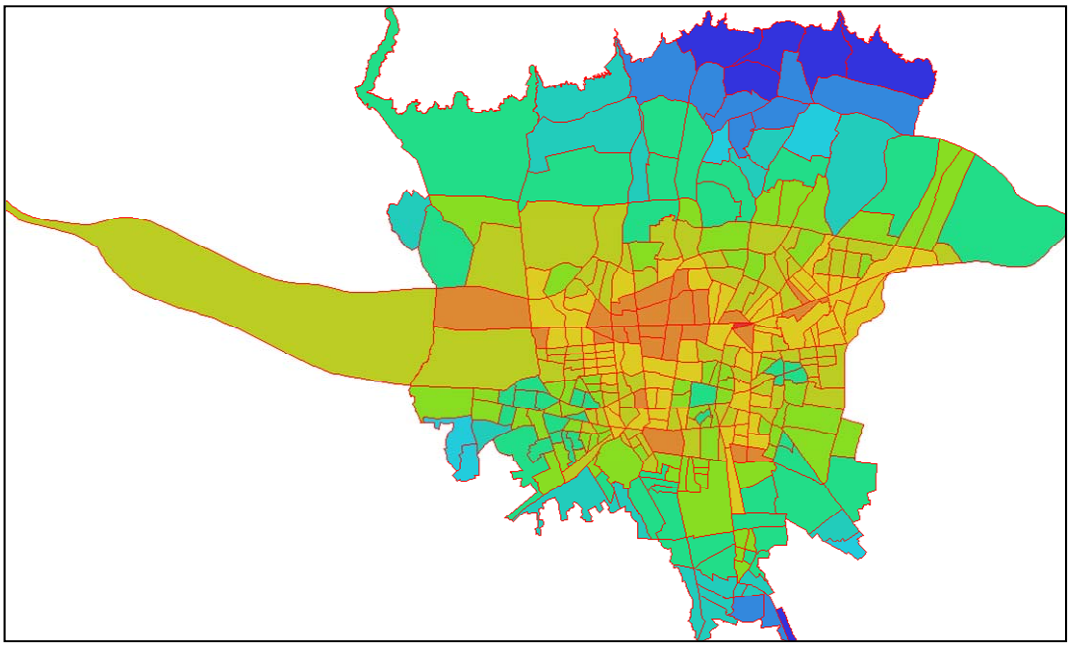

Figure 5-10: The mean value of global integration in each neighbourhood of the city

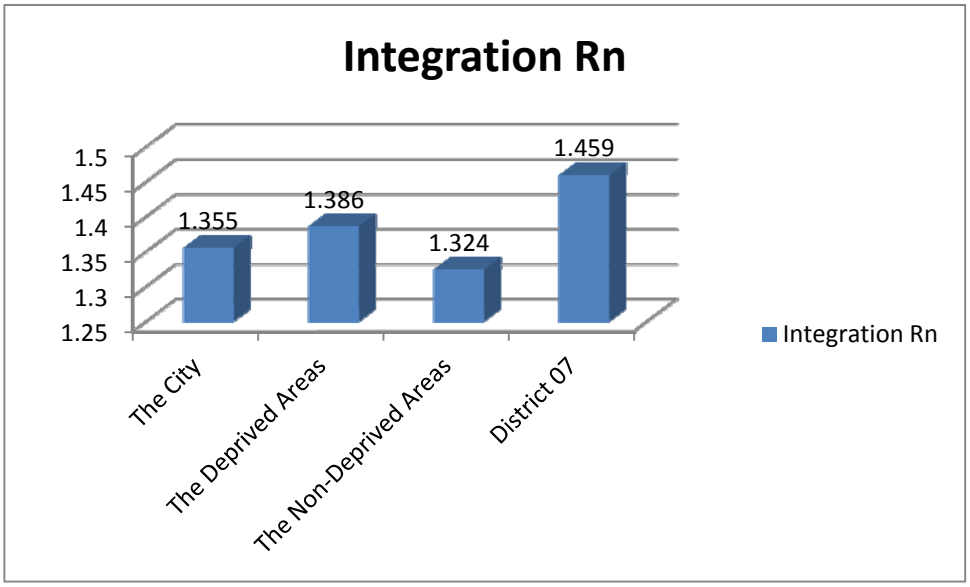

Figure 5-11: The comparison between the mean values of global integration in the city

The comparative study shows that the mean value of global integration in the deteriorating areas is more than both the non-deteriorating areas as well as the whole city. It also shows that the deteriorating case of this research has a higher mean value of global integration in comparison to the whole deteriorating areas. The reason for this is the location of the deteriorating areas in Tehran. In fact, the deteriorating areas in Tehran are mainly concentrated in the city centre which shows that these neighbourhoods mostly became degenerated as a result of a fast urban development process; a process in which these

neighbourhoods could not integrate with. As a consequence, the mean value of global integration in the deteriorating area becomes highlighted due to the highly integrated streets in the vicinity of these areas. Figure 5-12 and Figure 5-13 show the same comparison for the local integration of Tehran's neighbourhoods.

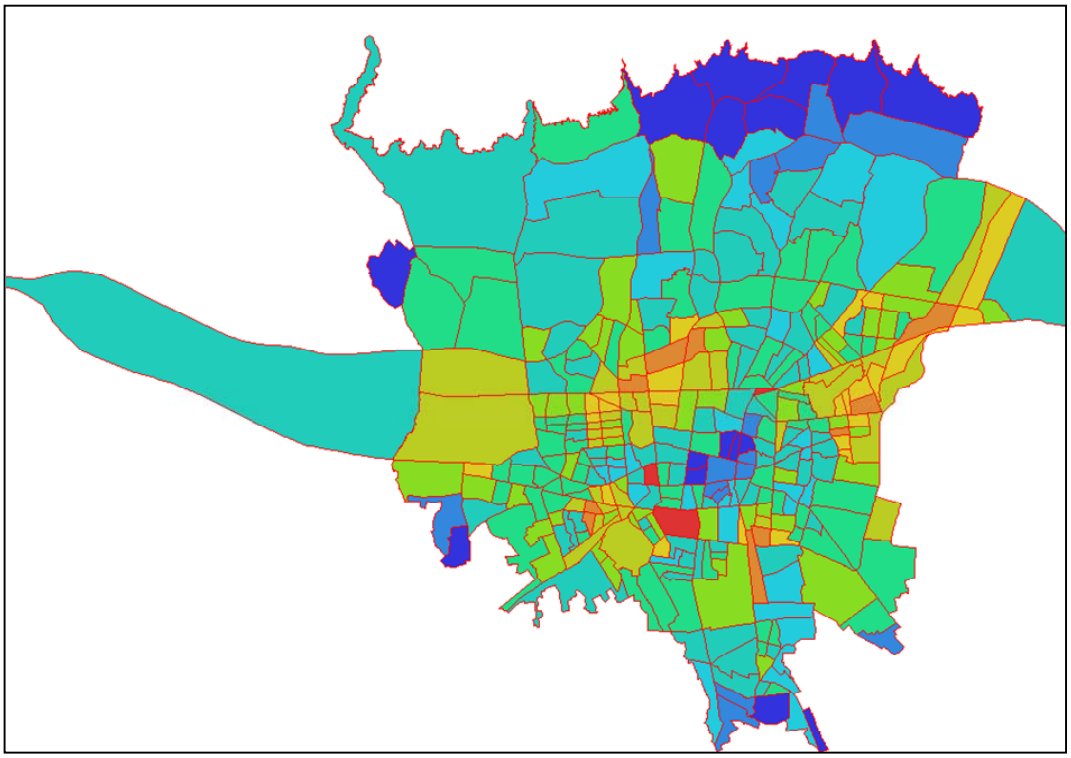

Figure 5-12: The mean value of local integration in each neighbourhood of the city

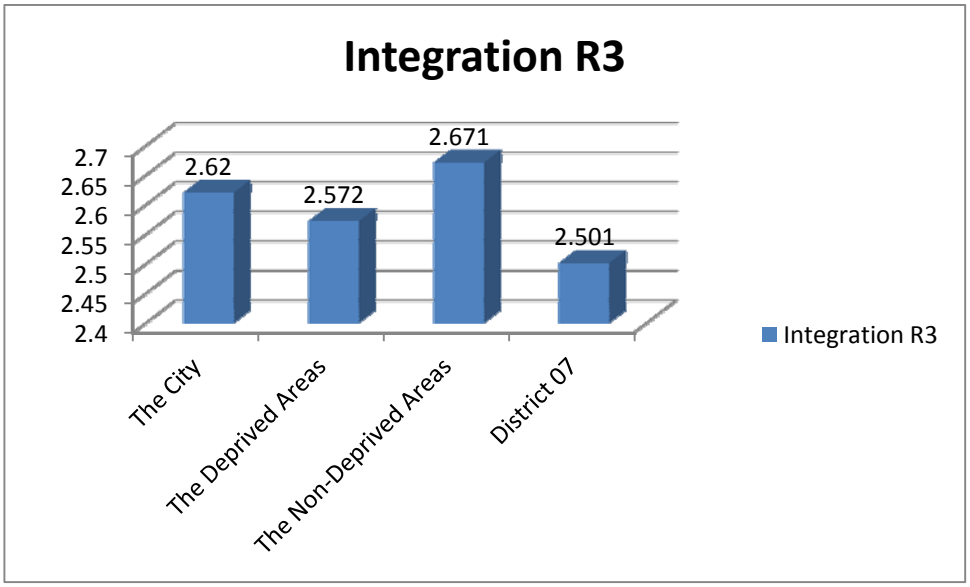

Figure 5-13: The comparison between the mean values of local integration in the city

The comparison between the mean values of local integration in the city interestingly reveals some other aspects of the deteriorating areas, including the case of this research. A comparison between Figure 5-135 and Figure 5-117 shows that while the mean value of the non-deteriorating areas is not considerable globally, it is significant locally and is more than the mean value of both the entire city and the deteriorating areas. Given that local integration reveals more inner structure of an area, depending on the radius of the analysis, this comparison confirms that although the non-deteriorating areas are not located necessarily at the edge of the most integrated streets, which causes a reduction in the mean value of global integration, their inner structure is well-integrated and the streets are more integrated locally and works better at the local scale. Considering the positive results from correlating the commercial land uses and integration R3, and linking the comparative studies with the result of section 5.2, it can be suggested that since the streets in the non-deteriorating areas are more integrated locally and the neighbourhoods have a high mean value of integration R3, they can more likely create opportunities for the creation of the commercial land uses and retailers, encouraging more socio-economic stimulant zones.

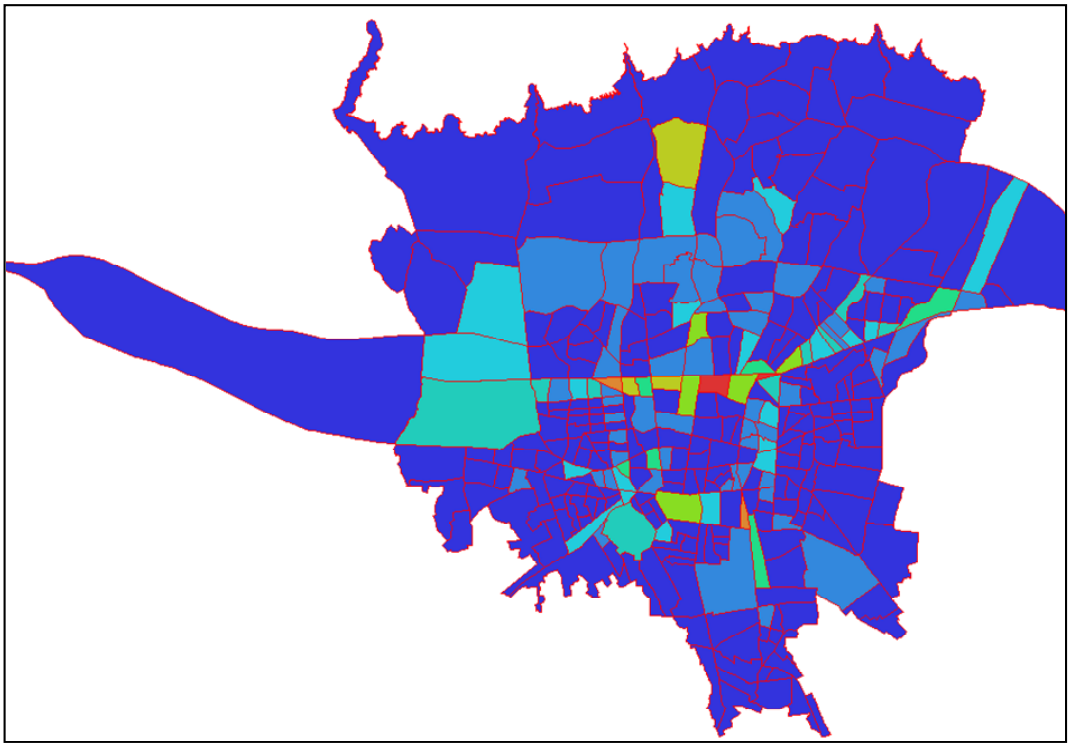

Figure 5-14: The mean value of choice Rn in each neighbourhood of the city

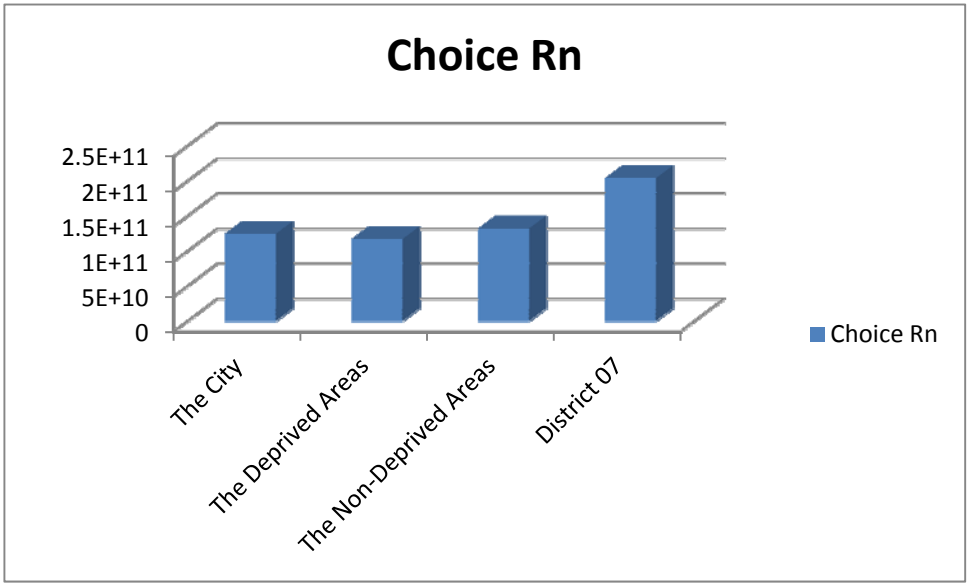

Figure 5-15: The comparison between the mean values of Choice Rn in the city

Figure 5-14 and Figure 5-15 show that the mean value of choice Rn is the highest in the non-deteriorating areas followed by the city, whereas the same measure for the deteriorating areas the less than the two. It also shows that the same measure in the deteriorating case of the research is considerably high.

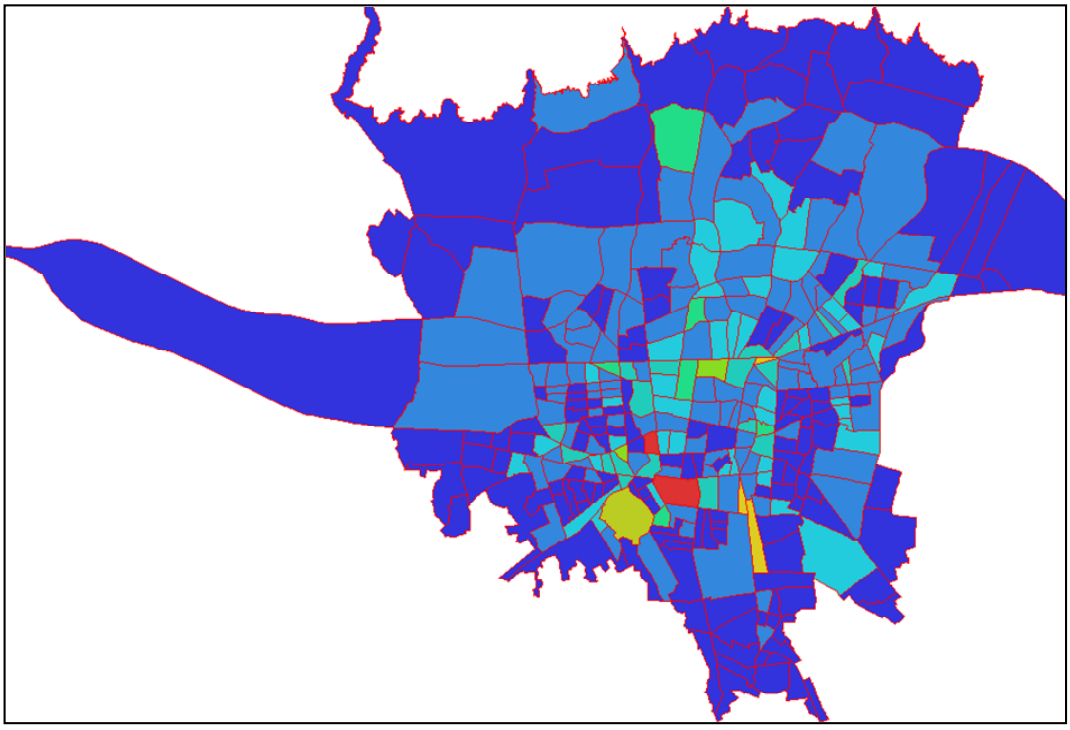

Figure 5-16: The mean value of choice R10000m in each neighbourhood of the city

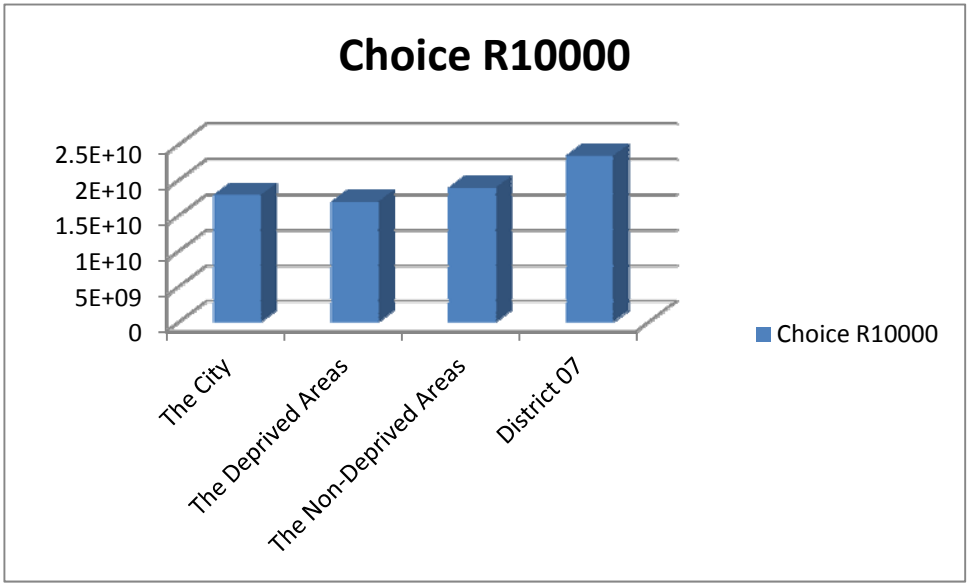

Figure 5-17: The comparison between the mean values of Choice R10000 in the city

Figure 5-16 and Figure 5-17 show that the mean value of choice R10000m is the highest in the non-deteriorating areas followed by the city, whereas the same measure for the deteriorating areas is less than the two. It also shows that the same measure in the deteriorating case of the research is considerably high. Additionally, it shows that the differences between the neighbourhoods in this radius decrease dramatically in comparison to choice Rn.

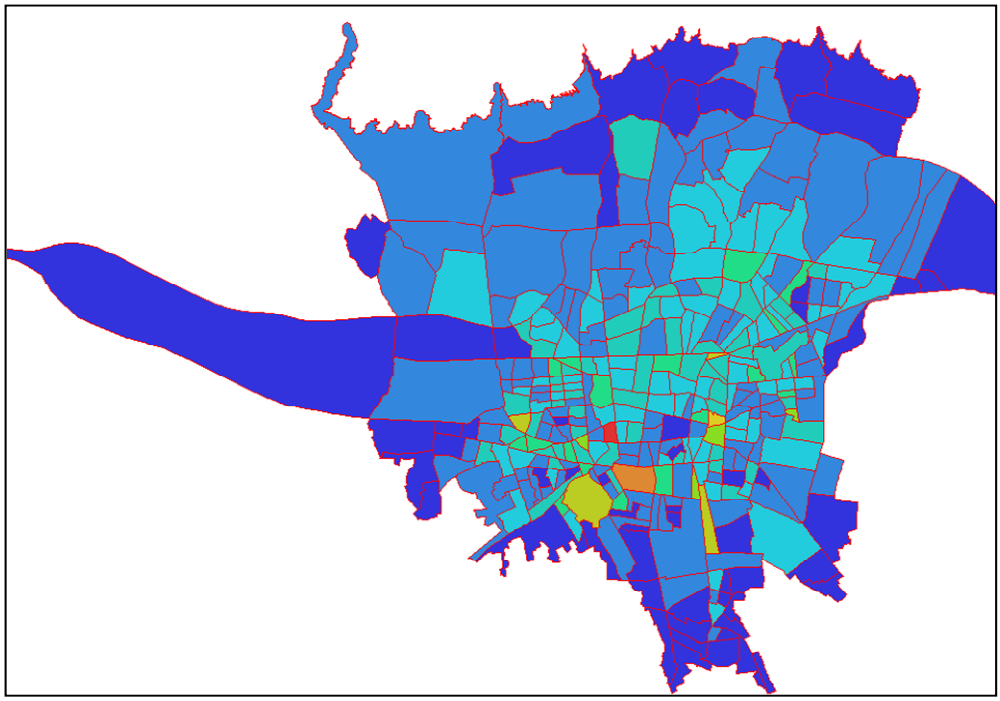

Figure 5-18: The mean value of choice R5000m in each neighbourhood of the city

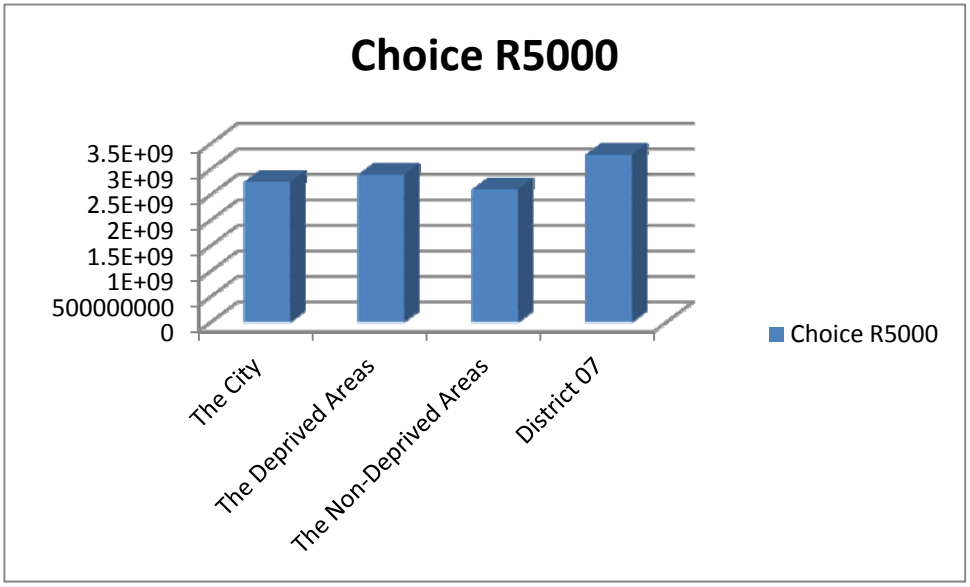

Figure 5-19: The comparison between the mean values of Choice R5000 in the city

Figure 5-18 and Figure 5-19 show that the mean value of choice R5000m is the highest in the deteriorating areas followed by the city, whereas the same measure for the non-deteriorating areas is less than the two. It also shows that the same measure in the deteriorating case of the research is considerably high.

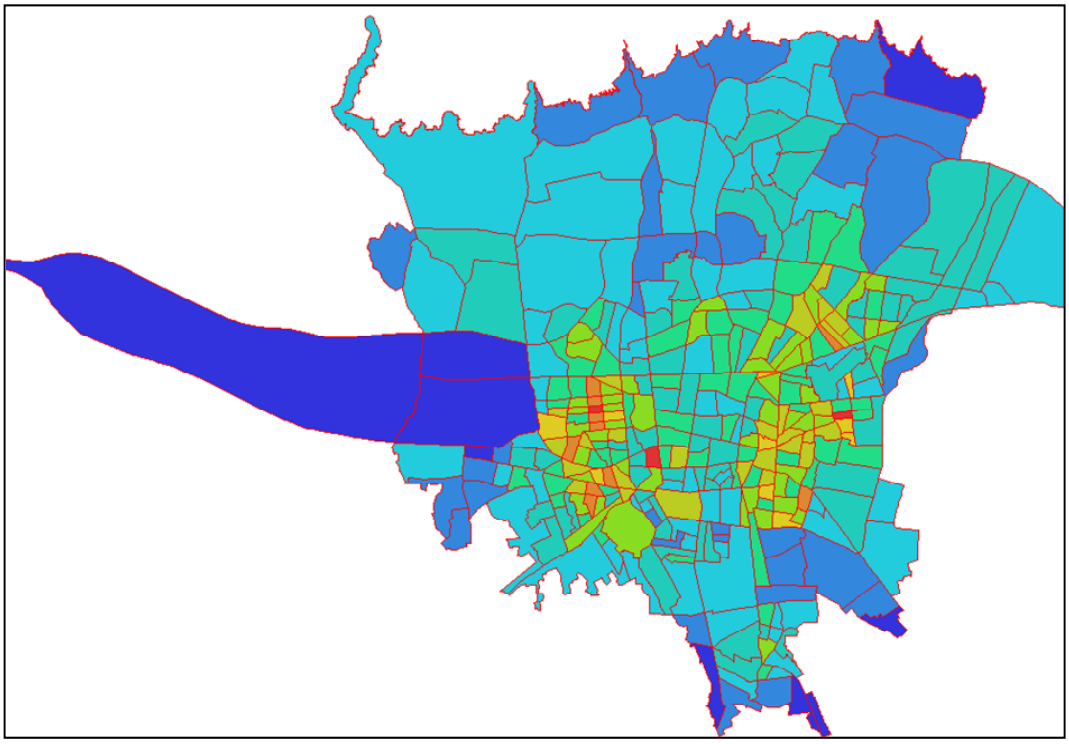

Figure 5-20: The mean value of choice R2000m in each neighbourhood of the city

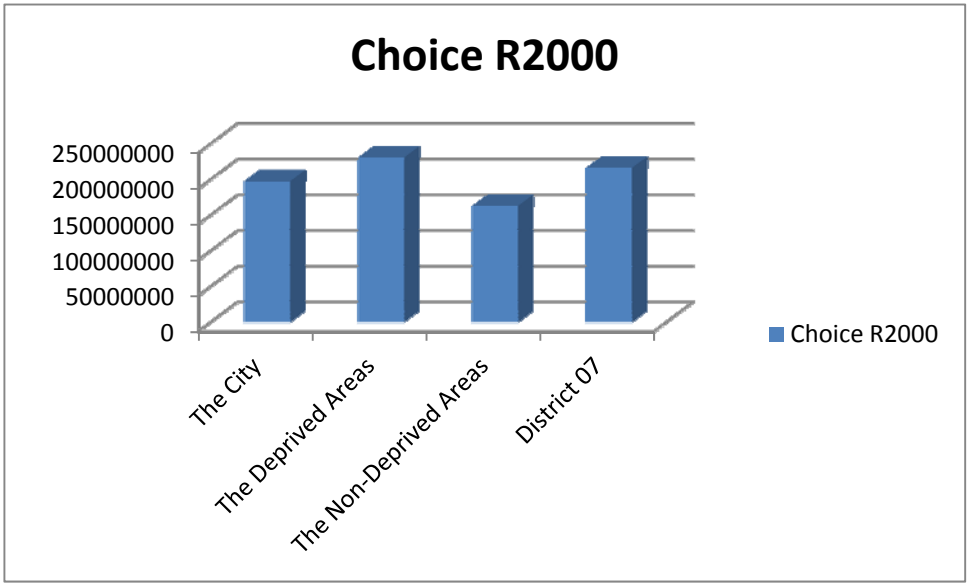

Figure 5-21: The comparison between the mean values of Choice R2000 in the city

Figure 5-20 and Figure 5-21 show that the mean value of choice R2000m is the highest in the deteriorating areas, followed by the city, whereas the same measure for the non-deteriorating areas is less than the two. It also shows that the same measure in the deteriorating case of the research is less than the mean value of the deteriorating areas.

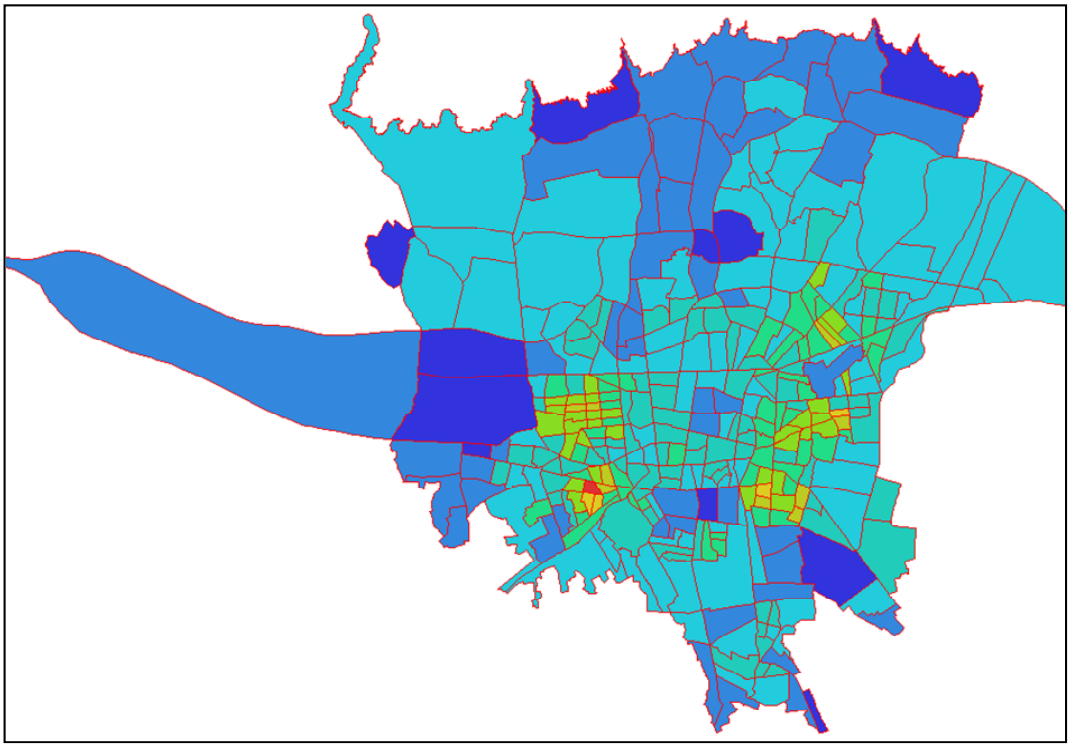

Figure 5-22: The mean value of choice R750m in each neighbourhood of the city

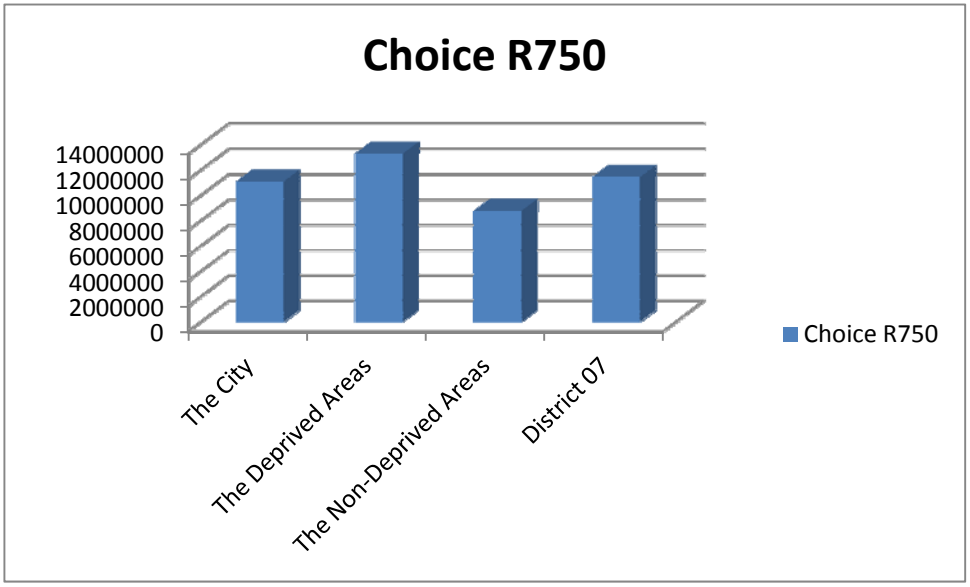

Figure 5-23: The comparison between the mean values of Choice R750 in the city

Figure 5-22 and Figure 5-23 show that the mean value of choice R750m is the highest in the deteriorating areas, followed by the city, whereas the same measure for the non-deteriorating areas are less than the two. It also shows that the same measure in the deteriorating case of the research is less than the mean value of the deteriorating areas.

5.4. **Results of behaviour mapping**

In sections 4.4 and 4.4.5, the observational methods and factor analysis have been discussed, and in this part the results are shown. At the first stage, the produced behaviour maps are shown to give the general idea how the behaviour mapping was conducted. In this section just one map for each street is presented as an example. The maps are produced in GIS using different symbols and the distribution of symbols, e.g. people who are passing, is illustrated randomly. Figure 5-24 to Figure 5-27 show the example of the maps produced for each section after conducting the behaviour mapping. Next to each map the symbols used to introduce the activities are also presented.

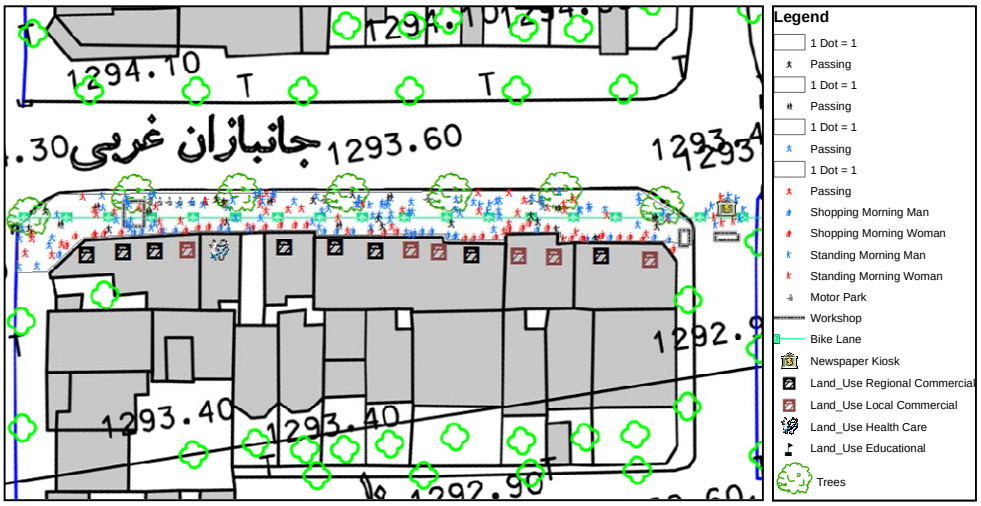

Figure 5-24: The map produced for section A of Janbazan Street

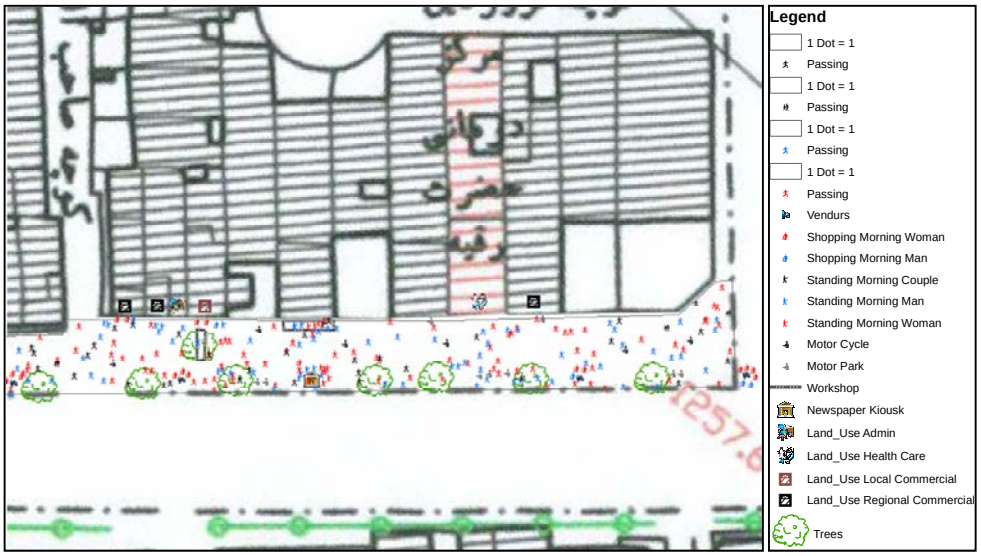

Figure 5-25: The map produced for section B of Madani Street

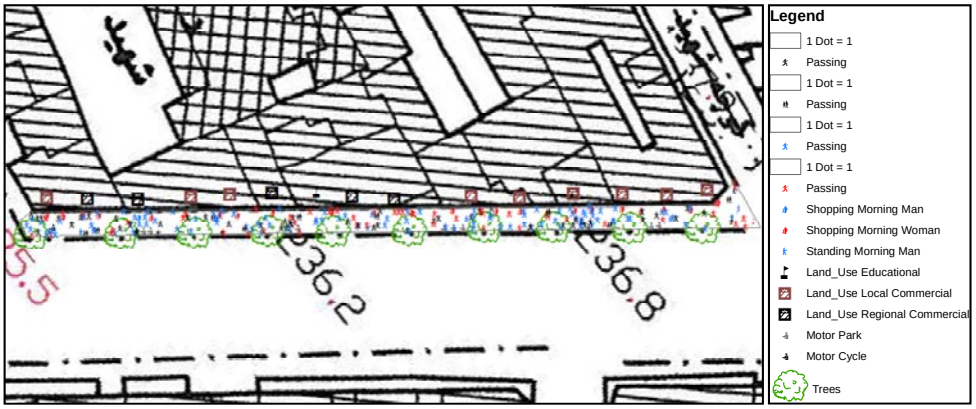

Figure 5-26: The map produced for section A of Namjoo Street

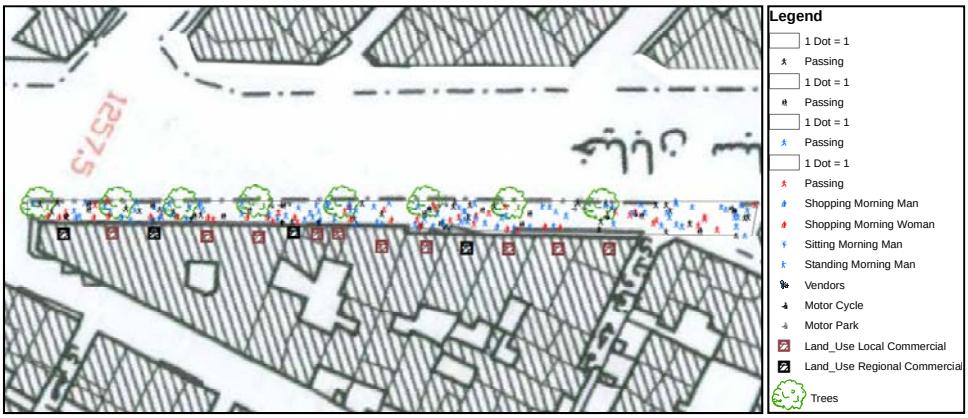

Figure 5-27: The map produced for section C of Sabalan Street

Although the purpose of behaviour mapping is to conduct statistical analysis and study the pattern behind the activities, the illustration of the maps, as shown above, helps to get a clearer idea of what happens in the streets. For instance, it helps identify which of the commercial land uses use the sidewalk as their workshop, or make it easier to understand the relation between people, vendors and kiosks. The produced database through observations also helps derive several descriptive analyses to study the pattern of observed activities and get a clear idea of the street life in the deteriorating area of this study. At the first stage, the relation between each activity with local and global integration is presented; however, it is acknowledged that observing more streets can illustrate a better picture in regard to the relation of syntactic measures and behaviours. The relations between different activities with each other are also presented which gives a clear idea of the street life in Tehran. In this regard, considering that 24 segments are observed carefully, the charts can present a consistent result of the relation between each activity with the others. In order to make it easier to read the charts, the total number of activities in morning, afternoon and evening are presented for each street and compared with the others. Figure 5-28 to Figure 5-35 show the charts and descriptive analyses extracted from observation; the reports of which are presented in the discussion chapter. Figure 5-28 shows the total number of people and the frequency of use in the total six observed segments in each street according to the time of day. Figure 5-29 and Figure 5-30 show the relationship between the presence of people in the total six observed segments of each street with global and local integration while Figure 5-31 and Figure 5-32 show the same relation only with the presence of women. Figure 5-33, Figure 5-34 and Figure 5-35 show the relation between local integration with necessary, optional and social activities for the four observed streets. Figure 5-36 and Figure 5-37 show the relation

between the activity of 'standing' for men and women with the presence of small businesses, such as kiosks and vendors, in the total six observed segments in each street, according to the time of day. Figure 5-38 shows the same relation for the activity of 'group walking' for women. Figure 5-39 and Figure 5-40 show the relation between hazardous activities with social and optional activities in the total six observed segments in each street according to the time of day. Finally Figure 5-41 shows the relation between the presence of men with the presence of women in the total six observed segments in each street according to the time of day.

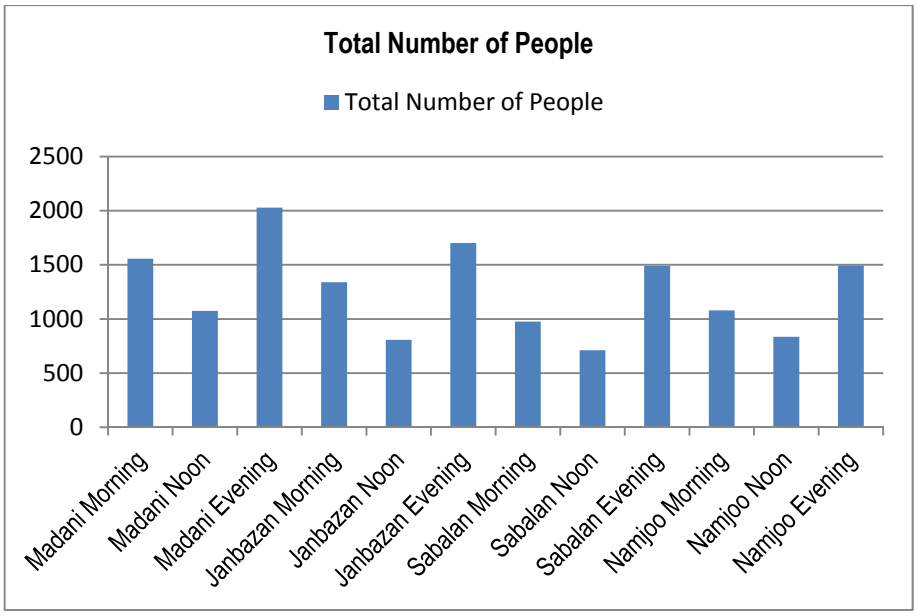

Figure 5-28: Total number of people in the streets according to the day time

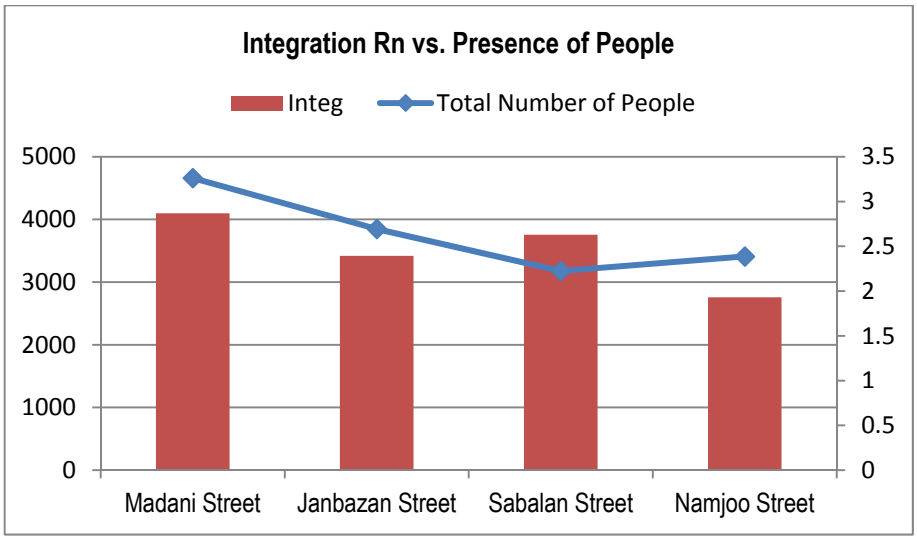

Figure 5-29: The relation between global integration and the number of people in the streets

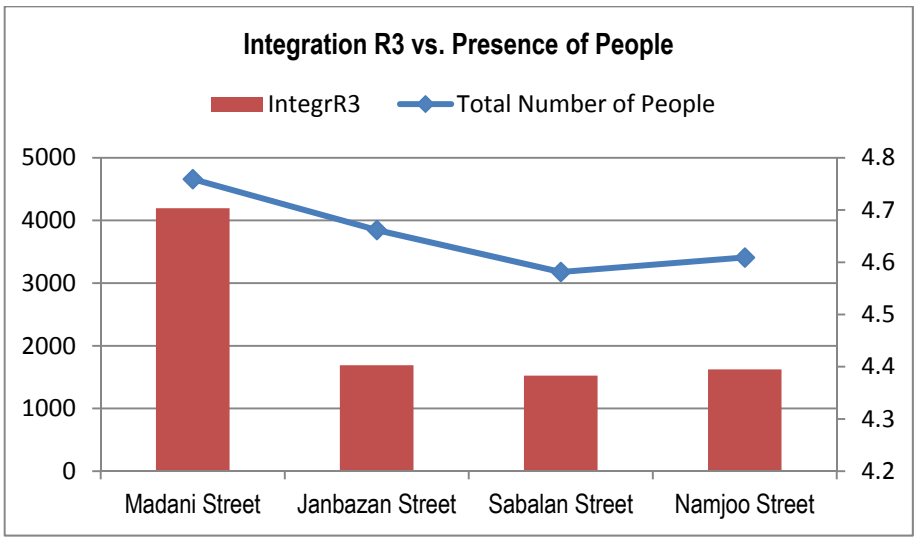

Figure 5-30: The relation between local integration and the number of people in the streets

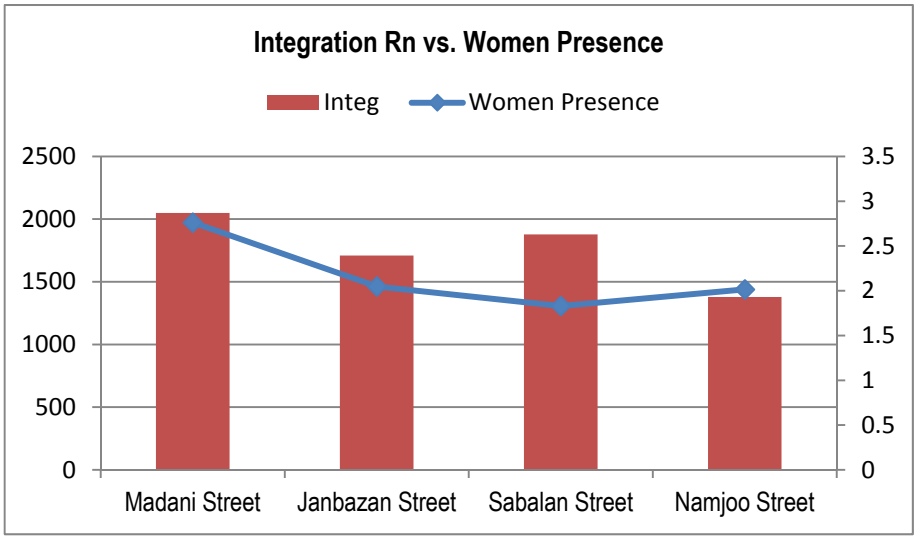

Figure 5-31: The relation between global integration and the number of women in the streets

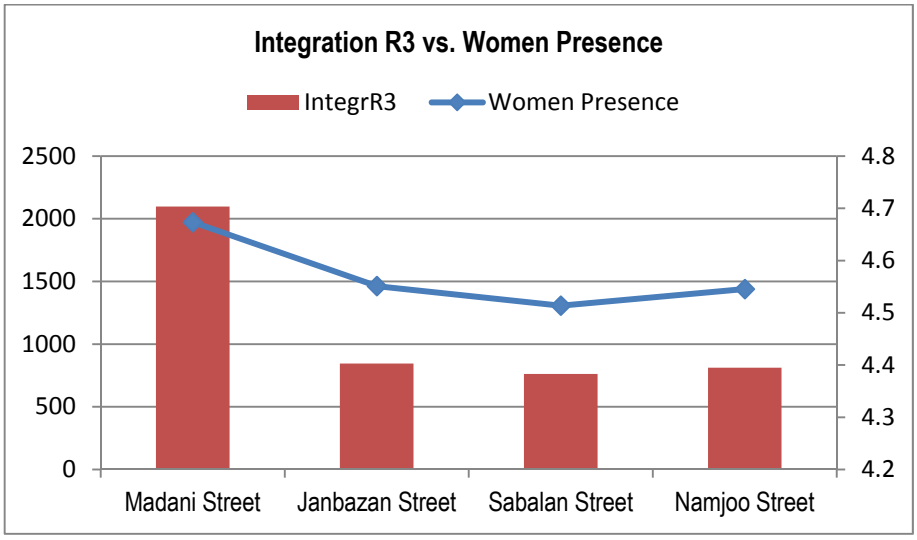

Figure 5-32: The relation between local integration and the number of women in the streets

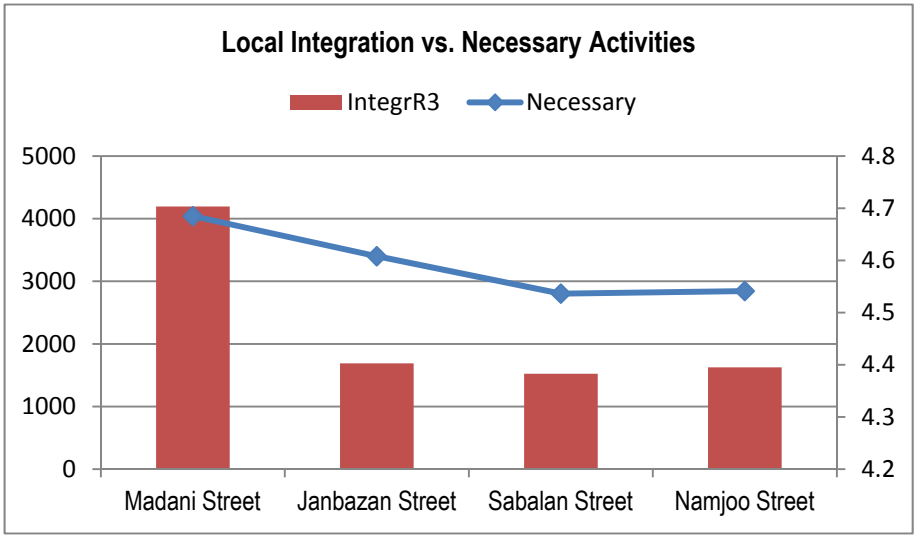

Figure 5-33: The relation between local integration and necessary activities

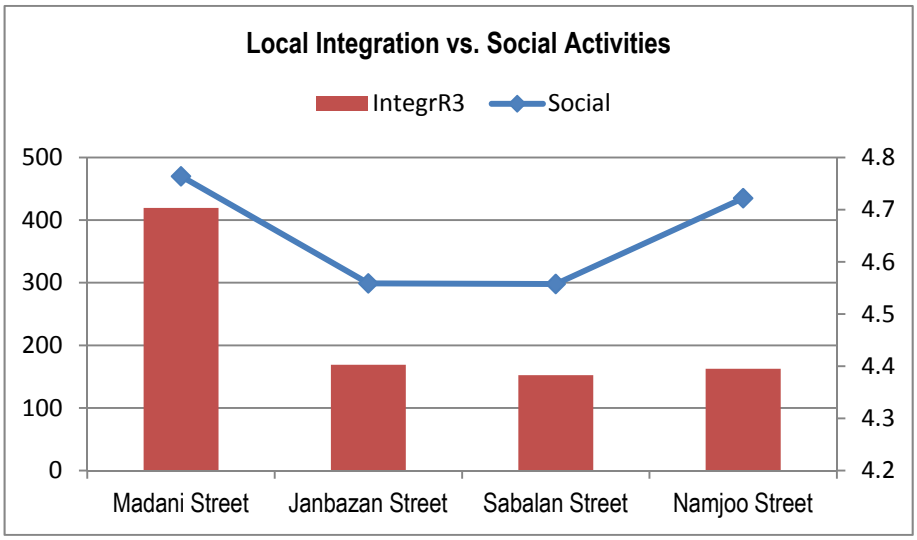

Figure 5-34: The relation between local integration and social activities

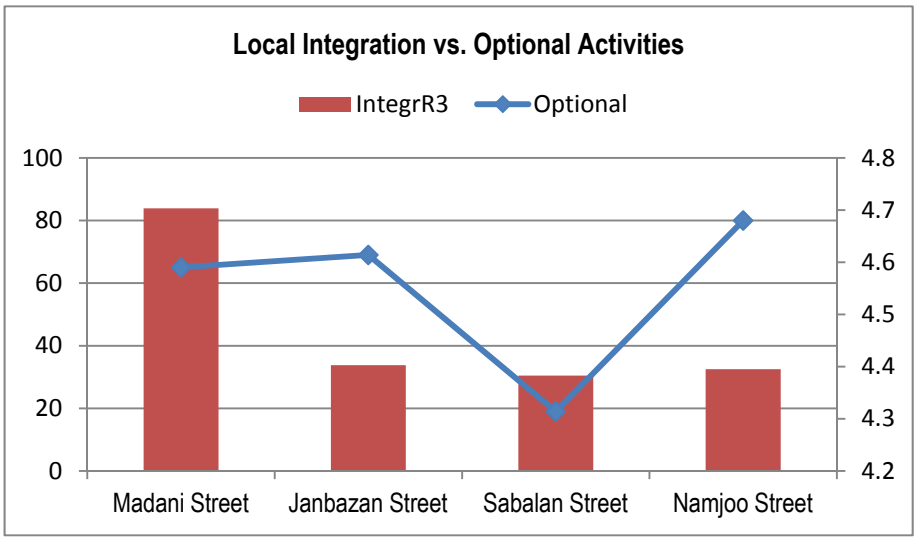

Figure 5-35: The relation between local integration and optional activities

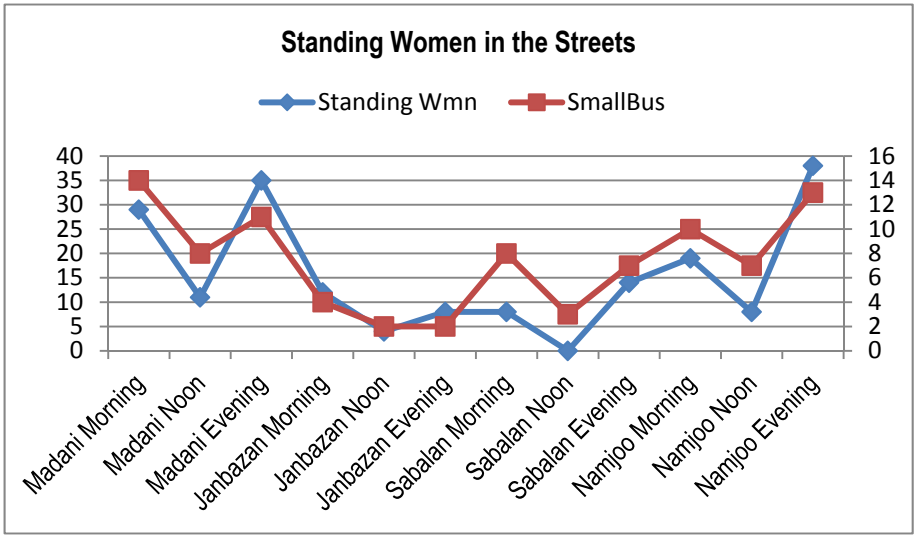

Figure 5-36: The relation between standing women and the presence of small businesses

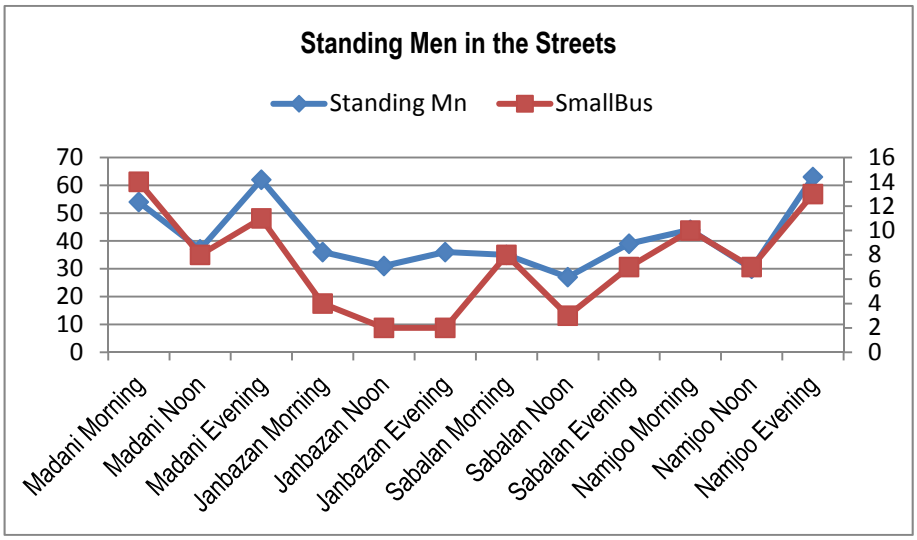

Figure 5-37: The relation between standing men and the presence of small businesses in the streets

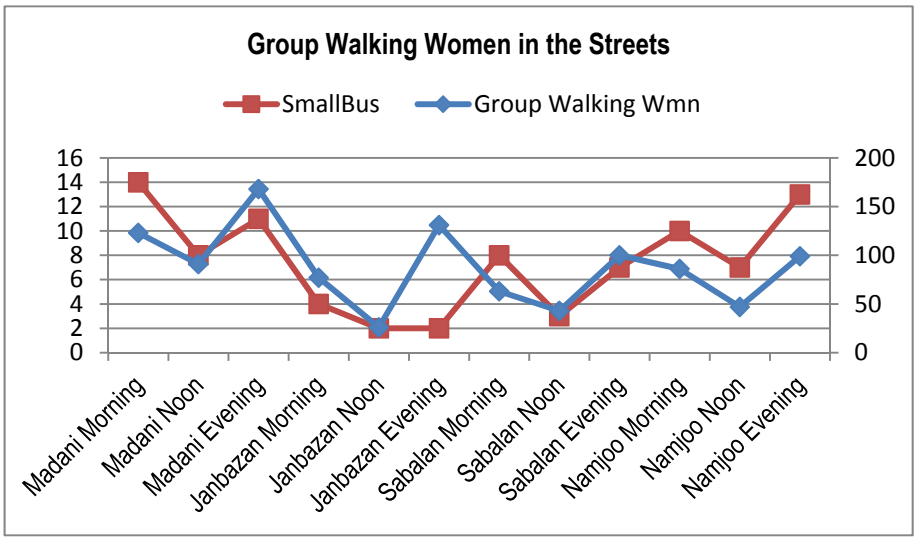

Figure 5-38: The relation between group walking women and the presence of small businesses

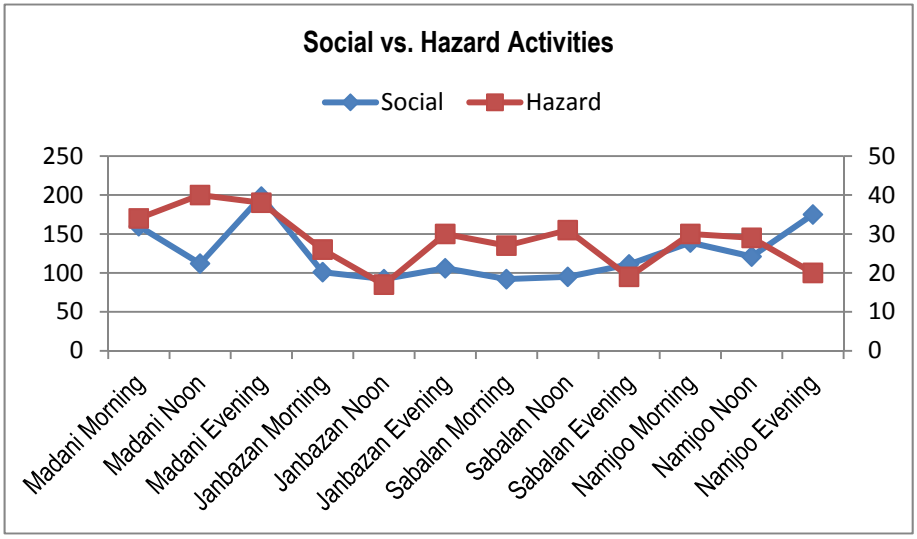

Figure 5-39: The relation between social and hazardous activities in the streets

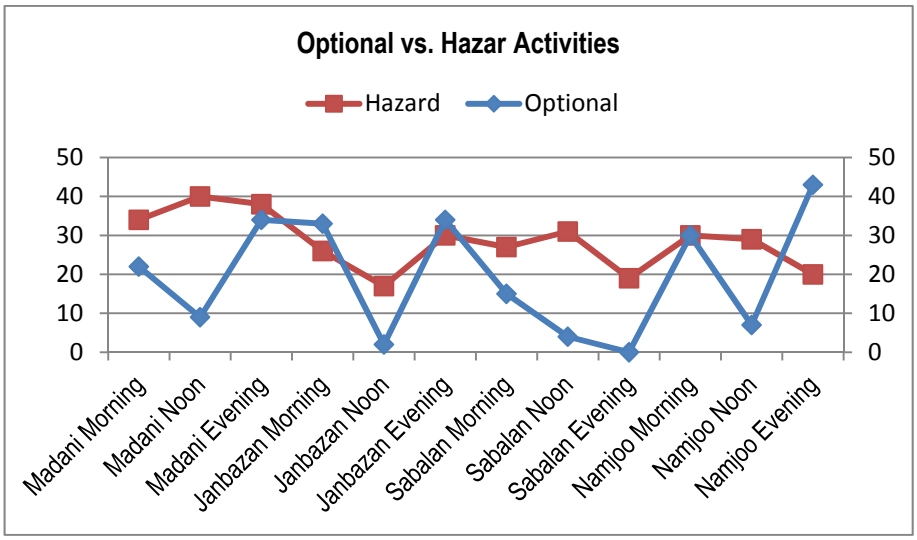

Figure 5-40: The relation between optional and hazardous activities in the streets

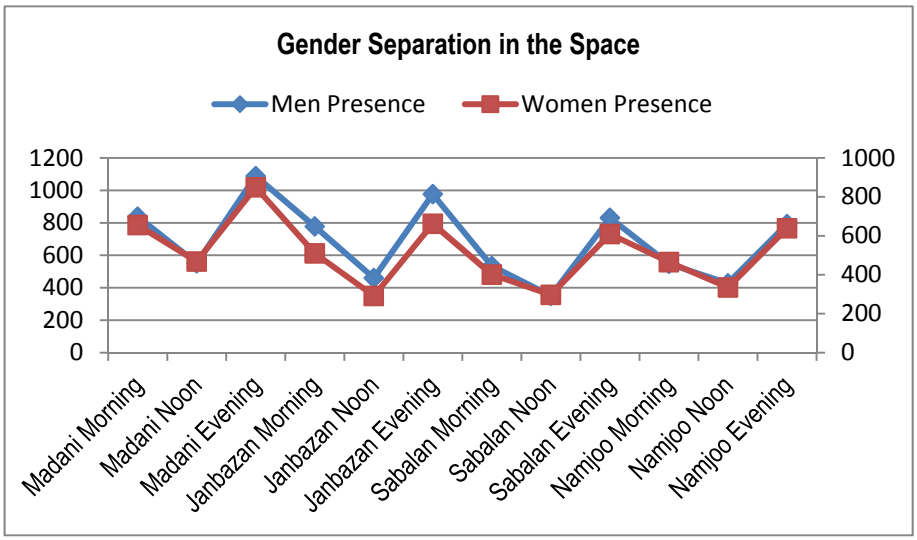

Figure 5-41: The relation between the presence of men and women in the streets

5.4.1. **Factor analysis of behaviour mapping**

After conducting the behaviour mapping a table of data was produced in Excel and the statistical analysis conducted in SPSS for conducing factor analysis. In order to check the collected data throughout the behaviour mapping method, the reliability test is conducted at the first stage using SPSS [Table 13 and Table 14]. It is commonly reported that the reliability test should have a minimum Cronbach's alpha value of 0.7, which in the case of this research is 0.755; therefore factor analysis was conducted at the next stage (Brace, Kemp & Snelgar, 2006).

Table 13: Case Processing Summary

		N	%
Cases	Valid	72	100.0
	Excluded[a]	0	.0
	Total	72	100.0

a. Listwise deletion based on all variables in the procedure.

Table 14: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
.755	.801	19

In factor analysis, the data is analysed by means of a principal factor analysis, with varimax rotation. The indicator of factorability of the data, Bartlett's test, is significant with $p < 0.05$ and the KMO test is 0.647 which is acceptable in applying the results of factor analysis [Table 15] (Brace, Kemp & Snelgar, 2006). Five factors with an eigenvalue of greater than 1.0 were found; the screen plot also indicated five factors [Figure 5-42]. The factors can be thought of as representing different classes of the observed street activities in Tehran by referring to Jan Gehl's classification (Gehl, 2006). The total variance explained by the factors is shown in Table 16. It shows that 24% of the activities can be explained by the first factor; 17.5% of activities can explain by the second factor; 11.5% of the activities can be explained by the third factors; 10.7% of activities can be explained by the fourth factor and finally nearly 9% of activities can be explained by the fifth factors. The result shows that these five factors can explain nearly 73% of all the observed activities.

Table 15: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.647
Bartlett's Test of Sphericity	Approx. Chi-Square	1224.699
	df	171
	Sig.	.000

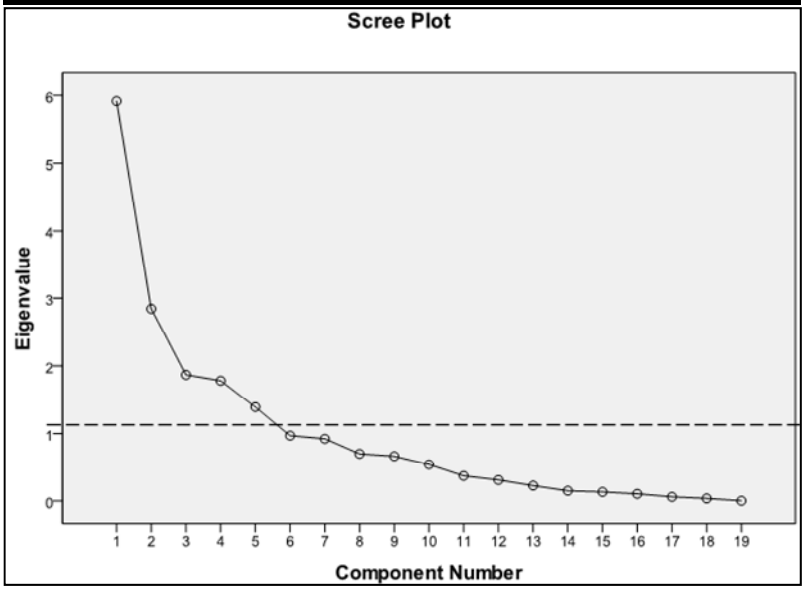

Figure 5-42: The screen plot also shows five factors with eigenvalue of greater than 1.0

Table 16: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.918	31.147	31.147	5.918	31.147	31.147	4.566	24.032	24.032
2	2.841	14.954	46.101	2.841	14.954	46.101	3.294	17.339	41.371
3	1.869	9.836	55.937	1.869	9.836	55.937	2.197	11.561	52.932
4	1.782	9.380	65.317	1.782	9.380	65.317	2.018	10.623	63.554
5	1.395	7.342	72.659	1.395	7.342	72.659	1.730	9.104	72.659
6	.970	5.108	77.766						
7	.923	4.859	82.625						
8	.700	3.683	86.309						
9	.664	3.497	89.806						
10	.541	2.845	92.650						
11	.371	1.954	94.604						
12	.310	1.634	96.239						
13	.227	1.193	97.431						
14	.150	.791	98.223						
15	.133	.700	98.923						
16	.105	.551	99.474						
17	.061	.319	99.793						
18	.037	.196	99.989						
19	.002	.011	100.000						

Extraction Method: Principal Component Analysis.

In the rotated factors, values less than 0.5 are 'suppressed' in SPSS to make it easier to read the rotated component matrix [Table 17]. The factors are then named in the rotated matrix based on the site observations and the literature. With regards to this, shopping, passing by, and group walking are categorised as the 'necessary activities' since they usually happen in the space regardless of the physical or spatial attributes of the space. Moreover, vendors, standing, cycling, and children walking are categorised as 'social activities' while sitting is considered as an 'optional' activity' (Gehl, 2006). The regional shops[39] and motorcycles are

[39] The shops which work at the regional scale in giving services

categorised as ‘hazardous activities’ but not because having regional shops in the streets are not welcomed. In fact, their presence is necessary in attracting more people from other neighbourhoods and encouraging socio-economic interaction. However, they can simultaneously attract activities such as motorcyclists and auto services, disturbing the privacy of the community and the social activities, which highlight the necessity of being controlled by specific regulations, although this is not relevant to this research. The kiosks and sleeping in the streets are categorised as the ‘occasional activities’ since, as the name says, they occasionally happen in the streets and have been observed in the data collection and cannot be ignored. However, they can have a great influence on street activities, especially kiosks and social activities, which is discussed in the next sections. It is important to acknowledge that any in-depth observation with more resources, including time and human resources, can come up with a finer result and grab a better perspective from the Tehran street. However, the conducted site observations in this research try to cover some of these limitations.

After identifying the pattern behind the observed street activities and categorising them, a correlation was conducted between the factors and the global and local integration of the observed street. Table 18 shows the results of this correlation. It shows that while the global integration does not have a significant positive correlation with any of the activities, the correlation of local integration is significantly positive with both the necessary and the social activities. The main point regarding this result is that for supporting the social activities in the streets, creating more sociable streets, the regeneration plans do not need to focus on the most globally integrated streets (which are more likely to be the main streets), but focusing on the locally integrated streets, which are integrated and accessible enough, could be another option. This approach keeps the traffic of the area under control and in the meantime supports the street activities locally. However, it is acknowledged in the research that the observed streets were limited to a fewer, manageable number, and observing more streets from the very segregated ones to the very integrated ones can project a clearer perspective in this regard. In that case, the result of having such correlation would be more reliable and meaningful; though it was decided to push the research forward with the available collected data.

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.Table 17: Rotated Component Matrix[a]

	Component				
	Necessary Activities	Social Activities	Optional Activities	Hazardous Activities	Occasional Activities
Shopping Man	.955				
Passing Mann	.933				
Passing Woman	.882				
Group Walking Man	.876				
Shopping Woman	.725				
Group Walking Woman	.667				
Vendors		.847			
Standing Man		.835			
Standing Woman		.828			
Walking Children		.614			
Cycling Man		.550			
Eating Man					
Sitting Man			.884		
Sitting Woman			.875		
Local Shops			.610		
Regional Shops				.928	
Motor				.926	
Kiosk					.724
Sleeping Man					.688

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 6 iterations.

Table 18: Correlations

		Necessary Activities	Social Activities	Optional Activities	Hazardous Activities	Occasional Activities
Integration	Pearson Correlation	.229	-.003	-.306**	.152	-.005
	Sig. (2-tailed)	.053	.978	.009	.202	.966
	N	72	72	72	72	72
IntegrationR3	Pearson Correlation	.318**	.250*	-.039	.201	.064
	Sig. (2-tailed)	.006	.034	.746	.091	.591
	N	72	72	72	72	72

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

5.5. **Results of route filtering system and the transformability index**

The importance of developing a route filtering system and a transformability index, as well as the methods by which they were developed, is discussed in sections 4.2.5 and 4.5. In this

section, the results of linking the route filtering system and the transformability index are shown. The results of correlating the commercial plots with the syntactic measures in section 5.2 show the significant positive correlation between integration and choice measures with commercial land use opportunities. Among the measures, integration R3 has the highest correlation with the commercial land uses. Also the results of the correlations between the activities and integration in section 5.4 show that local integration has a significant positive correlation with both the necessary activities and the social activities. Thus, this measure, integration R3, is considered as the base measure in the route filtering system in order to increase the integration of the area. With regards to this, the streets are classified based on their local integration value in three classes of high, middle, and low potential streets. It is highlighted that the aim of developing the route filtering system is to identify the potential of each street in increasing the integration of the neighbourhood, and to develop a plan in which the low potential streets join to the middle potential streets, and the streets in the middle class join to the streets in the higher class, and finally the whole network joins to the main street of the area [see Figure 4-11]. In Figure 5-43 the main streets are shown in red and the high potential streets are shown in orange, whereas in Figure 5-44, the middle potential streets are shown in green and the low potential streets are shown in blue. The locations of the deteriorating areas are shown with black boundaries.

Figure 5-43: The main streets (left); the high potential streets (right)

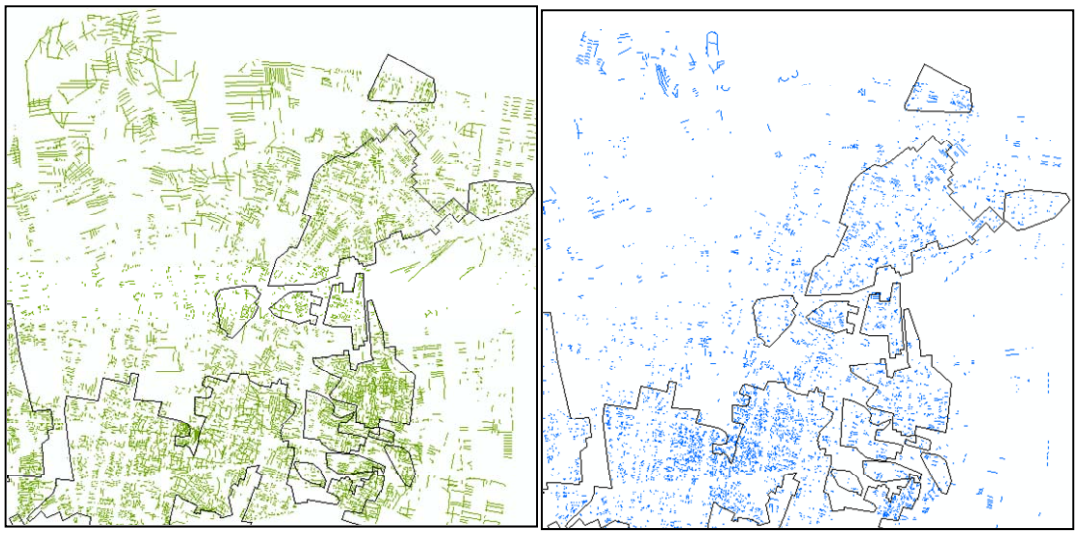

Figure 5-44: The middle potential streets (left); the low potential streets (right)

Figure 5-44 shows the accumulation of the low potential streets at the deteriorating areas and highlights the spatial problems of these areas. The plan is reducing the hazardous streets and increasing their potential in terms of becoming more integrated to the surrounding urban fabric. As can be seen in Figure 5-43 and Figure 5-44, so many lines are highlighted as the high potential streets and the middle potential streets. The question here is which one to choose for further development. With regards to this, the control layer using the choice measure is applied to narrow down the possible routes for further development [see section 4.2.5]. In order to develop a control layer in the route filtering system, the choice measure was used since the literature highlights this measure to be also an intuitive model for movement (Turner, 2007a, Hillier, Iida, 2005). Another reason for using the choice measure as the control layer is that, as mentioned previously, the choice measure at a specific radius could identify segments with a significantly higher value than others which may be acted as local 'seeds' for the development of the centre (Hillier, 2009). These 'local seeds' are in fact the 'socio-economic stimulant zones' the TCRO is seeking for which could trigger the socio-economic regeneration in the deteriorating areas. In this regard, different radii of this measure including Rn, R10000, R5000, R2000, and R750 were classified in five classes using the natural break method in GIS. Afterwards, in order to consider as many routes as possible in the system, the three top classes where extracted as the streets which have a high value of choice at a specific radius [Figure 5-45, Figure 5-46, Figure 5-47].

Figure 5-45: The Tehran Master Plan (left); high potential streets, choice Rn (right)

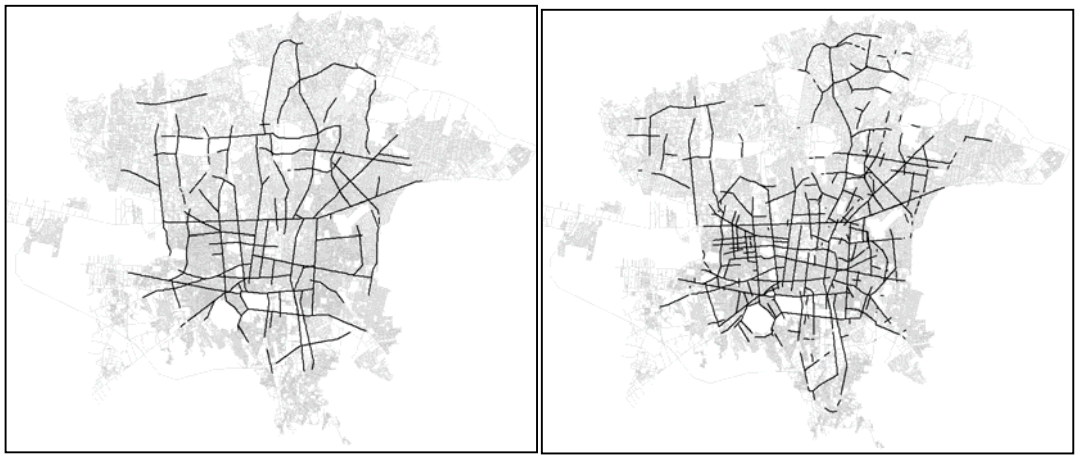

Figure 5-46: High potential streets, choice R10000 (left); high potential streets, choice R5000 (right)

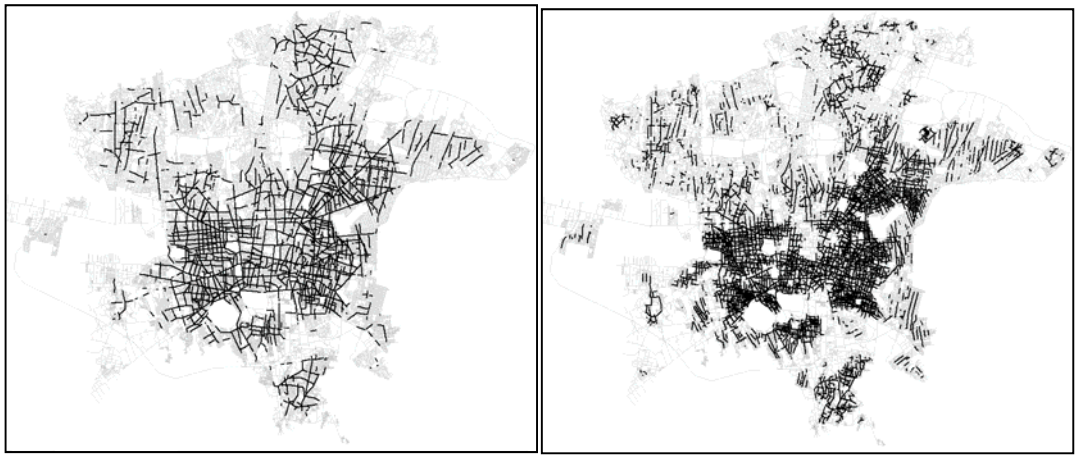

Figure 5-47: High potential streets, choice R2000 (left); high potential streets, choice R750 (right)

Figure 5-45 (right) shows the streets with a high value of choice Rn and highlights the streets that connect the different parts of the city from north to south and east to west. Figure 5-46 (left) shows the streets with a high value of choice R10000m and highlights the streets that connect different urban districts together. Figure 5-46 (right) shows the streets with a high

value of choice R5000m highlighting the streets at the sub-district level. Figure 5-47 (left), shows the streets with a high value of choice R2000m and highlihts the streets which connect different neighbourhoods in the city districts. And finally, Figure 5-47 (right) shows the streets with a high value of choice R750m and highlights the streets at the neighbourhood scale. The overlapping of these layers are shown in Figure 5-48.

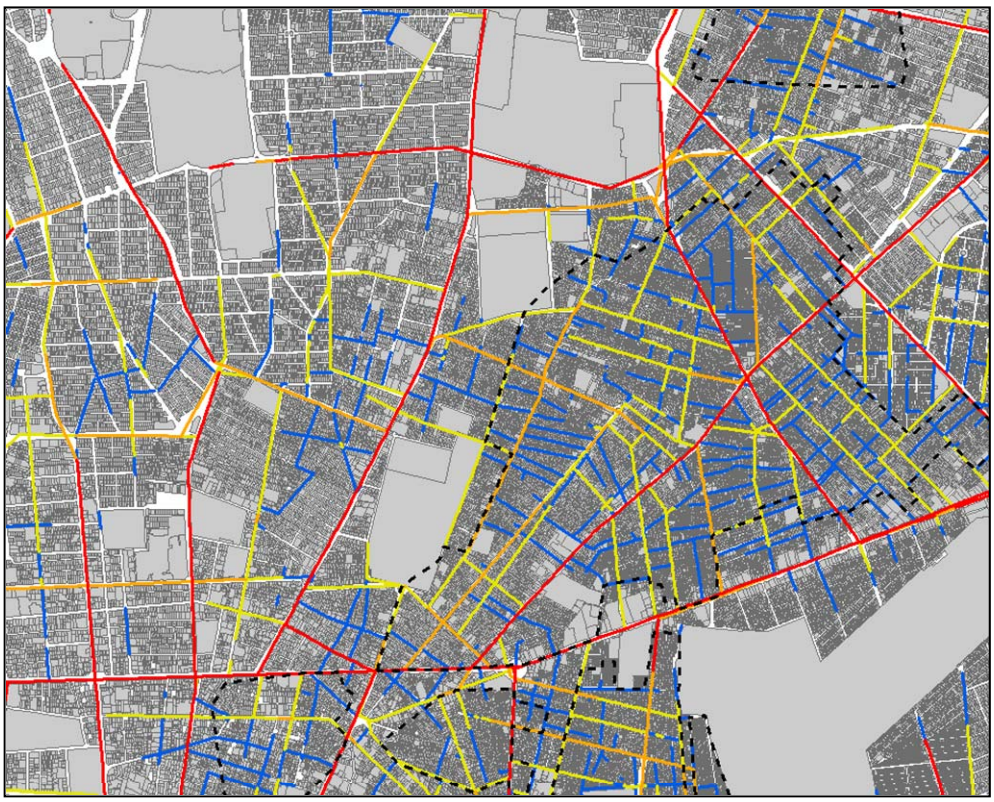

Figure 5-48: Overlapping the selected routes in different radii in the case study, Tehran districts 07-08

In order to filter the street for further development among the high and middle potential streets, the ones that overlap with the control layer, showing the streets with a high value of choice in different radii, should be prioritised. Thus, through the route filtering system among the very high and middle potential streets, just a few of them would be selected as the first priority for further development. Applying this approach could help to capture the streets with both a high value of local integration and a high value of choice; the two measures which are highlighted to be a strong predictor of movement (Turner, 2007a, Hillier, Iida, 2005). Although Karimi et al. (2007) applied a route filtering system as well, classifying the streets based on the local integration, considering the result of the correlations, and overlapping it with the control layer to prioritise the streets for further development, is an initial approach and the contribution of this research into this idea.

The importance of the transformability index in considering the socio-economic condition of the deteriorating areas, as well as the indicators applied in developing the index is discussed in section 4.5. In this section the results of applying the scores for the deteriorating case and the maps are presented. After scoring the indicators and sub-indicators, representing the socio-economic condition of the neighbourhoods, each parcel of the deteriorating area was weighted based on the scores in GIS, and the whole area is then coloured from dark to light based on the weight of each parcel to help to understand the situation of the neighbourhood. The darker the parcel is the easier the parcel can be manipulated [Figure 5-49]. The coloured map can facilitate the process of route filtering while having a primary idea of the cost of selecting one route or the other.

Figure 5-49: The transformability index

6. Chapter Six: Discussions

In the previous chapter the results of applying the methods for the case of Tehran are shown. In this section the results of each method are analysed individually and then it is discussed how the results support the assumption of the research and how they help the research to investigate the research questions.

6.1. What has emerged from the results of applying space syntax for Tehran?

Since one of the main purposes of this research is to deliver rigorous maps and evidences in regard to the spatial structure of the city, the reliability of the produced maps is important for this research. With regard to this, the result of applying space syntax for Tehran is compared with the literature to verify the reliability of the maps.

Figure 5-1 shows the distribution of the global integration in the entire city with the most integrated street in the middle, Enghelab Street, as the most accessible street of the city, which is also supported by Madanipour (1998) [see Figure 3-10]. Moreover, as can be seen in Figure 5-1, the Tehran axial map consists of a very small number of long lines and a very large number of small lines. In fact, the length of almost 72% of the lines is below the average line length. This is consistent to Hillier's point of view that the street networks of the cities consist of a very small number of long lines and a very large number of small lines – verifying the application of space syntax for the case of Tehran (Hillier, Vaughan, 2007).

In terms of studying the urban structure in the context of this research, Hillier's idea, regarding the city centre as including the most integrated streets located in or near the geographical centre of the city, can also be seen in the Tehran axial map [Figure 5-1]. This shows that Bertaud's idea regarding Tehran as a 'polycentric' city is not completely correct since the syntactic analysis of Tehran verifies that from configurational point of view Tehran has a strong city centre where the most integrated lines are congested [Figure 5-1]. However, Bertaud's ideas could be also justified with Hillier's idea regarding the notion of centrality. In this regard it can be said that firstly the city of Tehran is formed of the expansion of several villages with their own centres and as Hillier highlighted with the idea of 'pervasive centrality' Tehran also follows a multi-scale centrality pattern. Secondly that Tehran, at its current condition, is a city which spatially has the potential of a mono-centric city – here meaning a

city with a strong CBD – but the decisions of the Municipality throughout the time made the city to function with polycentric attributes – in terms of the location of the CBD, land price, the distribution pattern of land use and population across the city, and etc as Bertaud's report shows.

The syntactic analysis of Tehran also shows that the whole system does not look like a 'wheel', as Hillier suggests (Hillier, Vaughan, 2007), but it is more homogeneous. The reason for this is the fact that the cities that Hillier examined are mono-centric cities – a city with a strong CBD e.g. London – whereas the CBDs in Tehran are dispersed across the city the city lacks having a strong CBD at the macro scale (Bertaud, 2003). With regards to this, some streets become movement-rich and some others become movement-poor and the activities and the land uses which benefit from the movement are attracted to the movement-rich streets, and this in turn causes more movement, while the land uses, such as residential, which does not benefit from movement, tend to be attracted to the movement-poor streets. On this point, Figure 5-1 shows that in the case of Tehran, also the residential areas in both north and south of the city are the most segregated areas, and are located near the movement-poor streets. This process creates several centres across the city locally and globally and the whole city becomes a network of several linked centres at different scales with residential areas forming the background or matrix (Hillier, Vaughan, 2007). For further investigation of this matter in the case of Tehran, the choice map, which shows the routes in different regions which may be used or visited more often in reaching the most integrated streets (Hillier, Vaughan, 2007), was overlapped with the Tehran Zoning Map extracted from the Tehran Master Plan [Figure 6-1]. The aim of producing this map was to see whether Hillier's idea, with respect to the relationship between the activities and the movement-rich streets and the foreground network of linked centres, is true or not. In this map, the city centres are highlighted in red, as well as the activity axis, and the streets with a high choice value (Rn) are highlighted in grey lines. This map confirms that the activity axis, in the case of Tehran, links the city centres and follows the streets with high choice value or the movement-rich streets. These similarities between the results derived from the maps and the literature confirm the validity of applying space syntax for the case of Tehran, and also verify the accuracy of the produced maps.

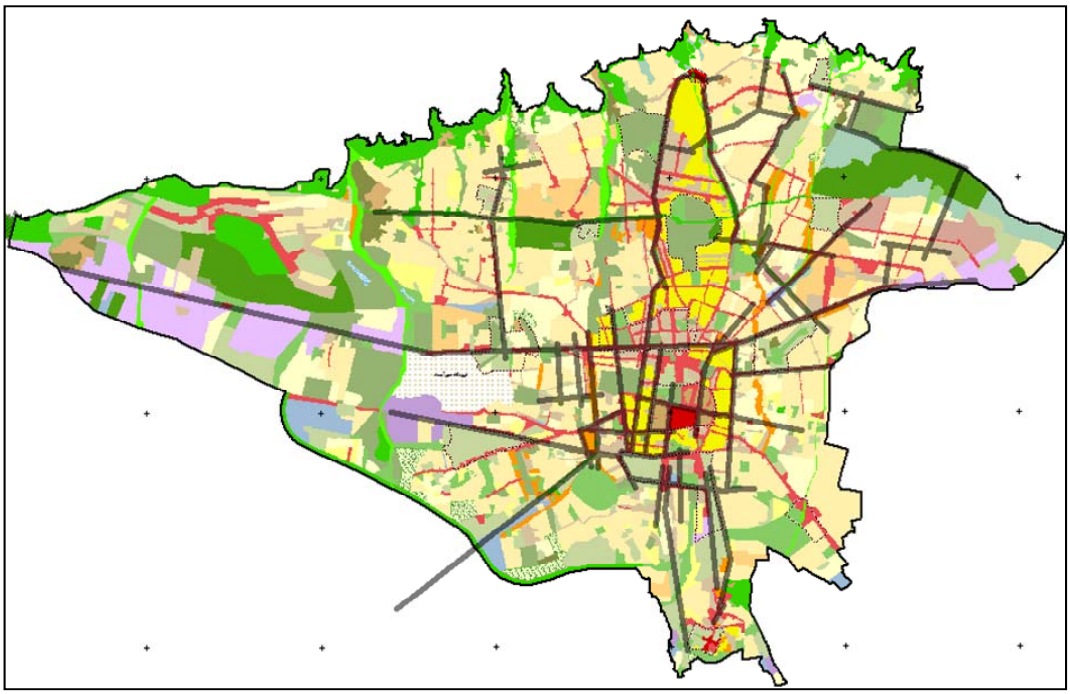

Figure 6-1: The overlap of the Tehran Zoning Map and the choice measure

6.1.1. **The condition of the deteriorating areas in the city structure**

The TCRO emphasises on considering the deteriorating areas in the whole city structure in order to optimise the regeneration plans and enhance the integration of the deteriorating area with the whole urban fabric more effectively. In this regard, the patterns of city expansion, and the condition of the deteriorating areas in it, are discussed here. The syntactic maps also show the pattern of city expansion. It shows that the city expands from the east to the west and then permeates into the neighbourhoods towards the north and the south of the city. Additionally, it shows how the main street of the city, Enghelab Street, cuts across the street and divides it into two parts and reinforces the bipolar attribute of the city (Bertaud, 2003). In order to show the pattern of the city expansion more clearly, its process is shown in four steps in Figure 6-2 with the location of the deteriorating areas in red.

Figure 6-2: The city expansion in four steps

Figure 6-2 shows that the deteriorated areas in Tehran are located just at the edge of the most integrated streets of the city, and in many cases the main streets of the deteriorated areas are highly integrated globally. It also shows that at the second step of increasing global integration in Figure 6-2, the deteriorating areas are almost covered. However, being located at the edge of the most integrated streets of the city, and having highly integrated streets in the deteriorating areas, should not mislead the judgment on spatial isolation of the deteriorating areas. In this respect, Figure 5-2 and Figure 5-4 show that while the most integrated street of the deteriorated area is connected to the most integrated street of the city, Enghelab Street, the inner streets of the neighbourhood remain segregated (or not integrated as much as it could be) which causes spatial isolation and consequently encourages social isolation; a condition which is also supported by Vaughan (2005). Additionally, Figure 5-3 and Figure 5-4 show that although the main streets in the deteriorated areas are highly integrated locally and globally, the level of integration decreases dramatically at the streets next to the most integrated ones, and, in some cases, creates a cluster of segregated streets. This tension can be seen in Figure 5-2 and Figure 5-4 by comparing the streets in the deteriorating areas and the streets in the control neighbourhood. In the control neighbourhood, the level of integration,

both locally and globally, decreases gradually from red to orange, yellow and blue. However, this is not the case in the deteriorating areas, which verifies the tension between the highly integrated streets and the surrounding urban fabric.

The two above sections highlight interesting points about the city of Tehran and the role of the deteriorating areas in the city. At the first part [6.1 6.1] it is verified that Tehran, spatially can have a strong city centre and follows Hillier's idea of 'multi-scale centrality'; however, it has the attributes of a polycentric city – in terms of the location of the CBD, land price, the distribution pattern of land use and population across the city, the pattern of daily trips and etc (Bertaud, 2003). This can be explained by having a look at the location of the deteriorating areas in Tehran. The location of the deteriorating areas shows that why a city with a mono-centric spatial structure and with a centre where the most integrated streets are congested, function like a polycentric city. In fact, the deteriorating areas are located just next to the most integrated streets of the city and since the government is neither capable of developing these areas nor have a methodological regeneration plan, the businesses and private sectors' activities become attracted to the other parts of the city and probably to the more locally integrated areas. In order to understand the spatial problem of the deteriorating areas which promote segregation and deprivation, the structure of the deteriorating area and the control area is compared in detail in the next part.

6.1.2. **Comparing the deteriorating case and the control case**

In order to highlight the accessibility problem of the deteriorating areas, a more technical and in-depth investigation is needed. Figure 5-4 shows that the most integrated street of the deteriorating area remains red, although it is surrounded by a cluster of blue lines representing a low level of integration. What is the reason for this level of integration? A more careful look at the case reveals that the main street in the deteriorating area is not red because it is well integrated with the surrounding urban fabric, but because it has a connectivity with the most integrated street of the whole city, which, as a consequence, increases the value of its integration. Actually, it seems that just for the ease of understanding the situation, the main street of the deteriorating area, shown with arrow in Figure 5-4, takes the integration into the deteriorating area, but as a result of the spatial layout of the area and that it is not well-connected with the surrounding urban fabric, it cannot distribute the integration and acts like a

dead-end in this regard. For investigating this matter in more detail, the comparison between the spatial structure of the control neighbourhood with the deteriorating area is presented.

Figure 6-3 shows the distribution pattern of global and local integration in the control neighbourhood. It shows that the most accessible streets, both globally and locally, form a framework across the area, working as the main structure of the control neighbourhood. It also shows that the most integrated streets globally are also the most integrated locally, covering the whole district from the north to the south. Moreover, it illustrates that there is a reasonable degree of connectivity between locally integrated streets, allowing the integration to be distributed homogeneously across the entire district, and linking different neighbourhoods within the district. This condition provides opportunities for people to be able to move from one neighbourhood to another easily and increases socio-economic interactions as well (Rismanchian, 2010). In fact, having a continuous framework of streets is one of the key points in encouraging pedestrian movement across an area (Rogers, 2005, Mansouri, 2008).

Figure 6-3: Left, Local Integration (R3) and Right, Global Integration for the control district 06

Figure 6-4 and Figure 6-5 show the global and local integration of the deteriorated neighbourhood as well as the most integrated street of the area with an arrow (the same street shown in Figure 5-2 and Figure 5-4). It shows that the most locally integrated streets do not necessarily integrate globally. It also shows that the most integrated streets do not cover the entire district. In fact, there is no reasonable degree of connectivity between the locally

integrated streets. Figure 6-5 shows that the most integrated street in the deteriorated neighbourhood is not connected to the rest of the integrated streets in the other neighbourhoods, and causes fragmentation in the main spatial structure of the whole area. Obviously, when the most integrated street of a neighbourhood becomes isolated, the whole neighbourhood suffers from spatial isolation and a lack of accessibility.

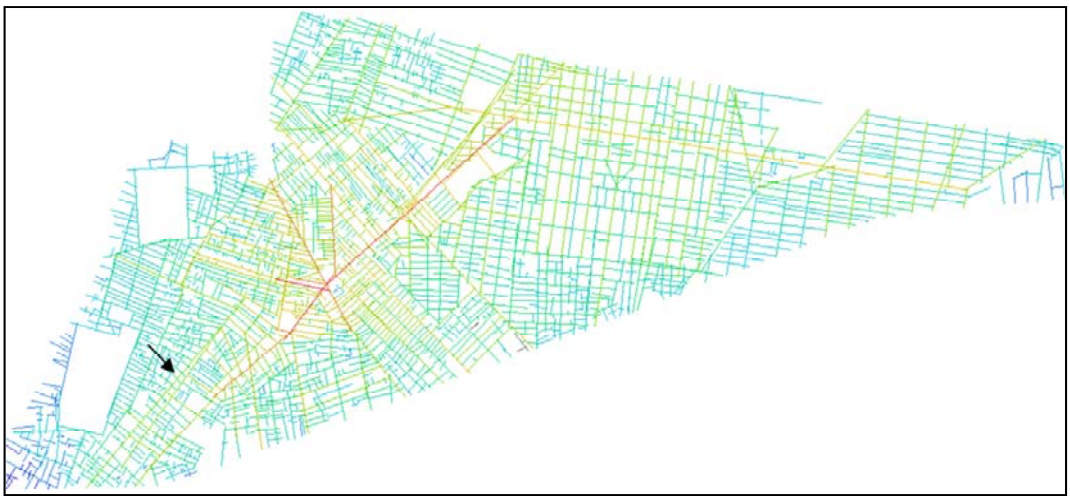

Figure 6-4: Global integration of the deteriorated neighbourhood in district 07, 08

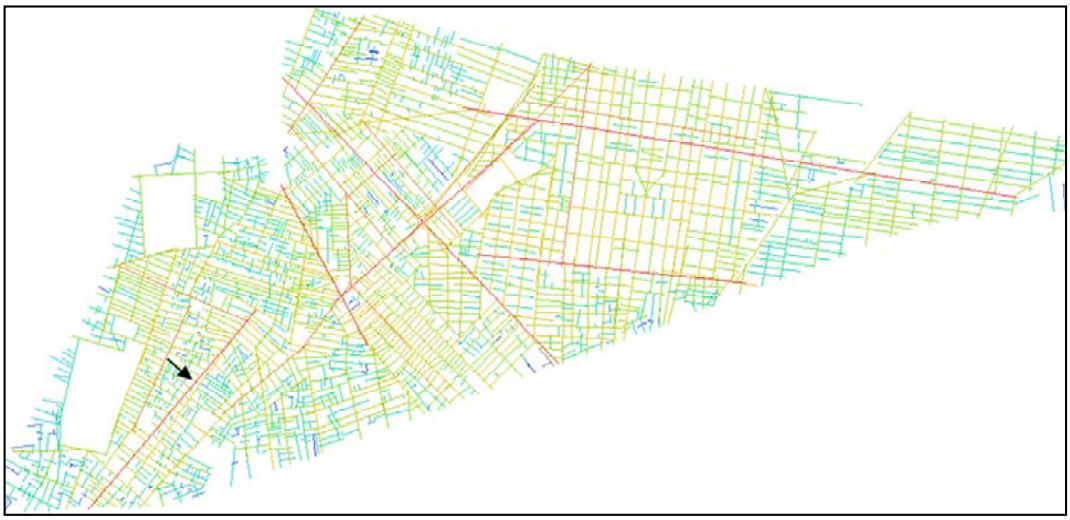

Figure 6-5: Local integration (R3) of the deteriorated neighbourhood in district 07, 08

This condition is also observable by studying the two cases in the whole urban structure. Figure 6-6 and Figure 6-7 show the gloabal and local integration of the axial line in the two case areas when anlalysed in the whole urban structure. The fragmentation of the most accessible streets in the deteriorating areas, shown with red boundaries, are highlighted in these two maps. It shows that while the most accessible street of the non-deteriorating area

forms a network covering the whole district, there is not a reasonable degree of connectivity between the most accessible streets in the deteriorating area.

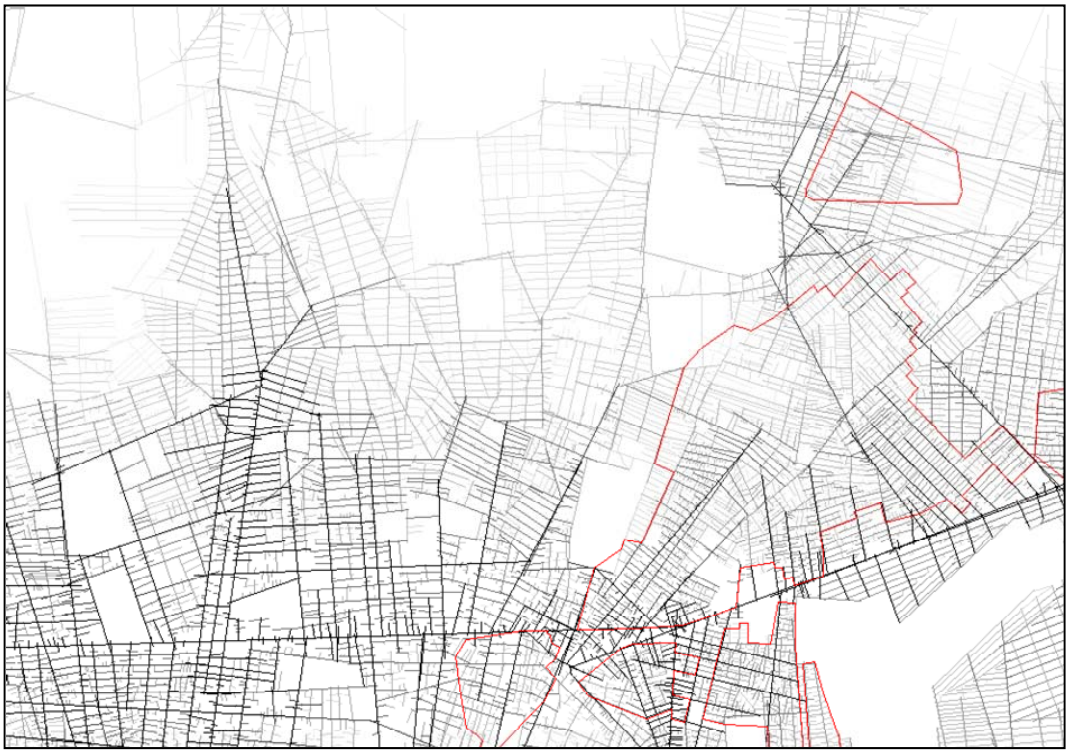

Figure 6-6: Global integration in the two case of studies

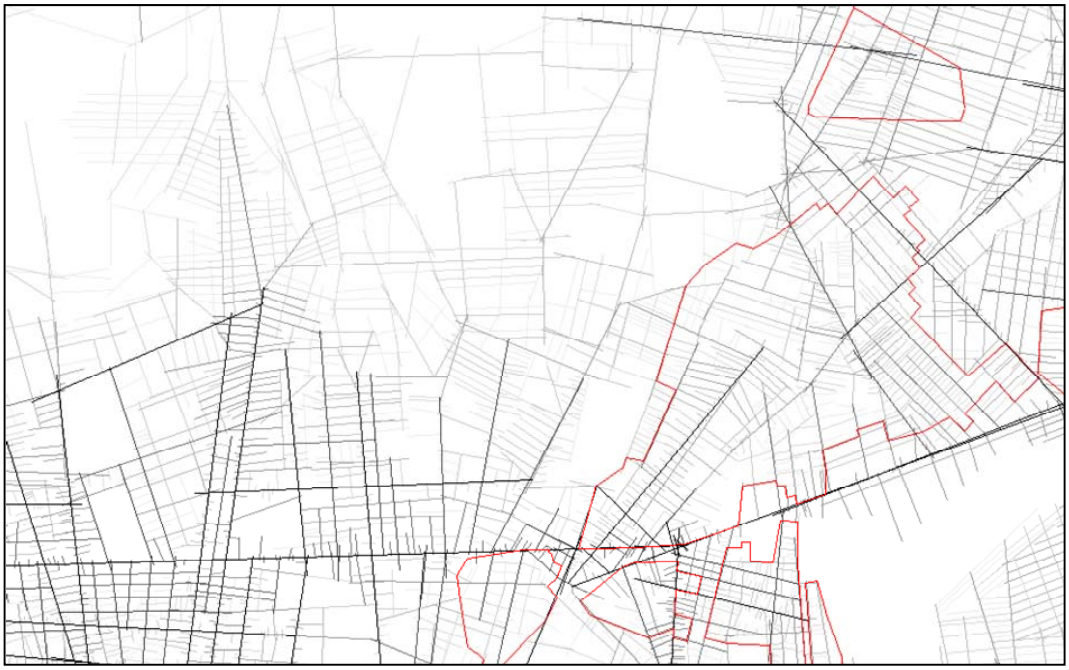

Figure 6-7: Local integration R3 in the two cases of study

Additionally, a comparative study on the distribution pattern of the choice measure in Figure 6-8 and Figure 6-9 shows that while the most integrated streets in the control neighbourhood facilitate the permeability to the neighbourhood and almost cover the whole district, the most integrated street in the deteriorated area is not contributing in this regard effectively, thus causing fragmentation in the main structure of the district.

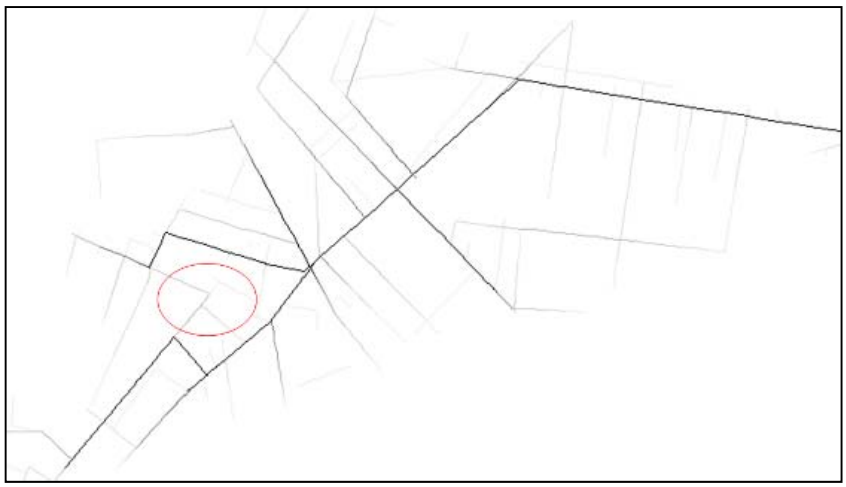

Figure 6-8: Topological choice measure for the deteriorated area

Figure 6-9: Topological choice measure for the control neighbourhood

The abovementioned discussions suggest that although it is easy to reach the deteriorating areas due to their location at the edge of the most integrated streets of the city, it is not easy to permeate to the neighbourhoods as a result of their inner spatial configuration. It also

implies that because the main street of the deteriorating area is not well-connected with the surrounding urban fabric, the routes which pass through neighbourhoods and can be used by people are getting fragmented, which discourages pedestrian visits from the areas and encourages isolation.

In terms of the spatial segregation or integration, the axial map of Tehran shows that many neighbourhoods that are not classified as deteriorated in the Tehran Master Plan are also segregated. However, there is a difference between 'voluntary segregation' in which a group of people with similarities, e.g. wealth, choose to be isolated from others, and 'involuntary segregation' in which a group of people become excluded from the society unwillingly (Vaughan, 2005). Her study about physical isolation and social marginalisation shows that, usually, deteriorating areas within the city appear near the city centre and at the edge of the most integrated streets. Their spatial condition is in such way that although the inner structure of the area is segregated, the main street of the area is connected with the most integrated streets of the city to ensure the economic survival of the neighbourhood. This is also the condition that can be seen in the deteriorating case of this research [Figure 5-4].

Hillier et al (2007) has also highlighted some attributes for the spatial structure of the deteriorating areas, including the short length of the axial lines and the complexity of the inner structure in the deteriorating areas. With regards to this, the deteriorated neighbourhood and the control neighbourhood are compared to see whether Hillier's idea, in terms of the spatial attributes of the deteriorated areas, is also applicable for the case of Tehran, or not. A comparison between the axial line map of a deteriorated area and the axial line map of the non-deteriorated area shows the reduction of the axial line length in the deteriorated area, which is accompanied by a small size of urban blocks and a more complex and disordered structure. A numeric comparison between the axial line lengths in the two maps also shows that the average line length in the control neighbourhood is 339.823, while it is 230.849 in the deteriorated area. This shows an almost 33% reduction on average of the axial line length.

The degree of complexity of the inner structure of the neighbourhood is another factor mentioned by Hillier et al (2007), applying to the deteriorated areas. Since there is usually an inverse correlation between the complexity of the structure and intelligibility – meaning the more complex the structure is, the less intelligible the area is – the intelligibility measure is investigated here. In order to do so, the axial lines of the two cases were extracted from the

Tehran axial map and the correlation between the local and global measures were calculated in the Depthmap software [Figure 6-10, Figure 6-11].

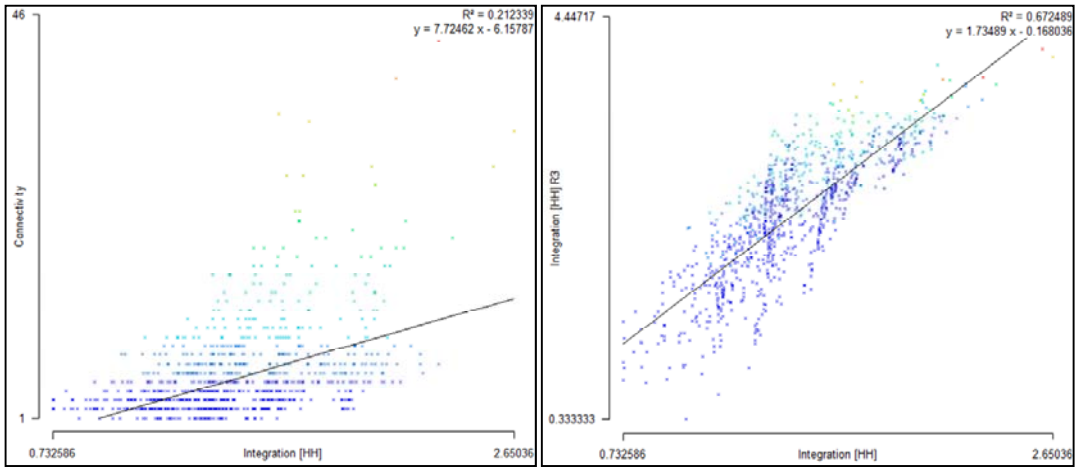

Figure 6-10: Correlation between integration Rn with connectivity and integration R3 for the control area

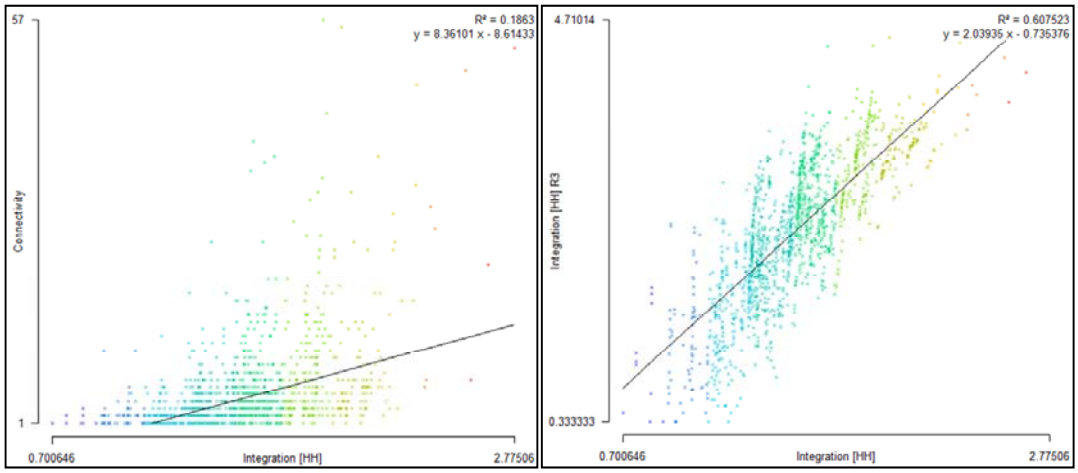

Figure 6-11: Correlation between integration Rn with connectivity and integration R3 for the deteriorating area

The results of this comparison show that the correlation between the local integration and the global integration in the control neighbourhood is R^2=0.672489, while the same result for the deteriorated area is R^2=0.607523, which shows almost a 10% decrease. Also the correlation between the degree of connectivity and global integration in the control neighbourhood is R^2=0.212339, while the same correlation for the deteriorated area is R^2=0.1863, which shows nearly a 12% decrease. As shown here the comparison between the control and the deteriorated areas confirms that the correlation between global integration, with both connectivity and local integration, is higher in the control area. This verifies the complexity of

the deteriorating area in comparison to the control case. These comparisons verify that the deteriorating case of this research has the same spatial attributes that Hillier has highlighted and suffers from spatial isolation.

The study of intelligibility in the deteriorating case can give the research an initial idea about the condition of pedestrian visit from the neighbourhood. In fact, according to the literature, which related systematic observation of street use to syntactic analysis, the integration and intelligibility of urban layouts are two significant factors that have implications for pedestrian movement (Ye, Josefsson, 1997). Hillier also has highlighted the correlation between spatial integration and movement, claiming that there is a positive correlation between intelligibility and movement, and as areas become less intelligible the relationship between spatial integration and movement reduces (Penn, 2001). Intelligibility can also be an indicator of way-finding, meaning that, in the intelligible system, the majority of all movement is relatively direct between origin and destination. There is no redundancy in the route, and a there is a great degree of similarity between the routes chosen by different subjects. However, in the unintelligible system, routes are far more distributed over the area. Routes are indirect and many show a high degree of inefficiency in way-finding. This might be the reason unintelligible environments are so personally, as well as socially, depriving in their effects (Penn, 2001). Considering the results of intelligibility in the deteriorating area, it can be assumed that the correlation between movement and integration is less than the non-deteriorating area and the routes of movement are less direct and more complex, discouraging pedestrian visits from the area and encouraging more social isolation in the deteriorating case of the research.

The results, discussions and evidence delivered in this section highlight the complexity and the configuration of the inner structure of the deteriorating case as the main problems of the area, which promote spatial segregation and cannot be enhanced merely by a street-widening policy. This confirms the assumption of the research with regards to the potential of the pedestrian-friendly street network development, which takes the current underlying spatial pattern of the area into account in changing the structure of the area and enhances the integration of it.

6.1.3. **Studying the distribution pattern of commercial land use**

In the abovementioned sections the method by which the correlation between spatial structure of the city and the distribution pattern of commercial plots across the city are discussed. In this regard it is important to say that in the case of this research all the commercial activities including retails, shopping centres and offices are considered as 'commercial plots' and were extracted from the Tehran GIS maps. This justifies the correlation between two measures of integration and choice produced by space syntax with different activities in the city and gives a clear but low-resolution idea of the distribution pattern of activities across the city. However, classifying the commercial plots based on their scale, e.g. retails, and studying them separately could give finer results which are beyond the scope of this research.

The statistical results on correlating the distribution pattern of commercial plots and syntactic measures show that there is a positive correlation between integration and choice with the amount of commercial land use (attractions), which based on the natural movement theory [Figure 2-13], could direct more pedestrian movement in return. Thus, in the case of Tehran, integration and choice can also be considered as a predictor and determinant factor of movement, and effective criteria for studying the notion of 'accessibility' and 'spatial isolation'. This positive correlation becomes more important in this research since the TCRO is looking for sections of the neighbourhood that could be considered as the 'socio-economic stimulant zones'. If this research would like to draw attentions to a pedestrian-friendly street network development, the elements of this network, which have more potential in creating commercial opportunities, should be highlighted as the 'socio-economic stimulant zones'.

The result of correlating the distribution pattern of commercial land use with syntactic measures suggests that, in the case of Tehran, the streets that are more integrated locally (R3), or are being regularly used at the local scale due to their spatial configuration in the area, have more potential in making opportunities for the creation of commercial land uses. With regards to Hillier's idea of natural movement (Hillier et al., 1993) and the bilinear affect of movement and attractions [Figure 2-13], it seems that in the case of Tehran the commercial land uses are more dependent on local trips rather than global trips. This can be supported by the fact that Tehran has the attributes of a polycentric city (Bertaud, 2003) in which each district has its own centre, attracting people and directing daily trips on a local scale.

This result simply implies that for avoiding car-orientated plans, the street network development, in which the network's main elements are highly integrated locally, has a greater chance in making a sociable street, due to the opportunities for the creation of commercial land uses and retailers. Thus, for any spatial intervention, the decision makers would be better to concentrate on the locally integrated streets and their potential for further developments.

6.1.4. The comparative study between the Tehran neighbourhoods

Considering the deteriorating areas in the whole city structure is the interest of the TCRO; although no methodological approach is introduced by the TCRO in addressing this idea. With respect to this, the research has studied the mean value of each syntactic measure in the Tehran neighbourhoods in order to consider the condition of each neighbourhood in the city structure and make a comparative study between the Tehran neighbourhoods possible.

Figure 5-10 to Figure 5-23 makes a good platform for a comparative study between Tehran's neighbourhoods, with regards to the probable number of visits by people in daily trips across different scales, from the global scale to the 750-metre trips. This would become highlighted since the literature signifies the correlation between spatial configuration and movement (Hillier et al., 1993). Space syntax analysis has found that spatial configuration correlates powerfully with observed movement; in statistical terms, between 60% and 80% of the variance in movement can be accounted for by measures of spatial configuration alone. This is especially the case in areas where land uses and development densities are relatively homogeneously distributed (Penn, 2001). Considering that Tehran is a homogenous city in which the city centres are dispersed (Bertaud, 2003) [also see the master plan Figure 6-1], it can be assumed that this would also be the case for Tehran as the spatial configuration is correlated with movement. In this regard, the comparison between the mean values of choice, illustrated in the above maps, is discussed here.

The produced maps suggest that in the macro scales, such as Rn and R10000m, the non-deteriorating areas have a higher mean value of choice, representing that the streets in the non-deteriorating areas might be used and visited more often for long trips. However, in the micro scales, such as R2000m and R750m, the deteriorating areas have a higher mean value of choice, representing that these neighbourhoods are being used and visited more often for shorter trips. This implies that the non-deteriorating areas are being visited by people from

different parts of the city as a result of the nature of long trips, and in return, more interaction between people from different social classes can be anticipated in these neighbourhoods. Whereas, the people who participate in short trips within a neighbourhood are usually the residents, and since the deteriorating areas are being visited more often in the short trips, it can be anticipated that social interaction occurs among the residents from the same neighbourhood and social class. In fact, since the streets of the deteriorating areas have a low choice value at macro scales, which means that they are probably not being used in the considerably longer trips, they cannot be visited by people from other neighbourhoods so often. This situation could encourage socio-economic isolation.

Having a look at district 07, the deteriorating case of this research, shows that it has very high choice value at almost all scales. So, does this mean that this neighbourhood is being visited at all the scales and does not have any socio-economic problem? In order to clarify this misunderstanding, it is firstly important to realise that in comparing the city's non-deteriorating areas and deteriorating areas, several districts and neighbourhoods have been taken into account. However, district 07 is just one district, and the differences between the streets can become highlighted in calculating the mean value. With regards to this, a more careful look at district 07 and its location in the city is required. Figure 6-12 shows the main streets of the city with a very high value of choice. It shows that several streets cut across from the western part of the district 07 which are the non-deteriorating areas, and as a consequence the mean value of the whole district increases dramatically, whereas just one street – shown with a double green arrow and the same street shown in Figure 5-4 – crosses the eastern part of the district, which are the deteriorating areas including neighbourhood 01-05. The location of the deteriorating areas in district 07 is shown in Figure 6-13, which clearly shows a contrast between the western part, which contains several streets with a high value of choice and integration, and the eastern part, which is the location of the deteriorating areas. This situation, a socio-economic and spatial gap between the two parts of the district, is also highlighted in a governmental report (Farnahad Urban Planning Company, 2005).

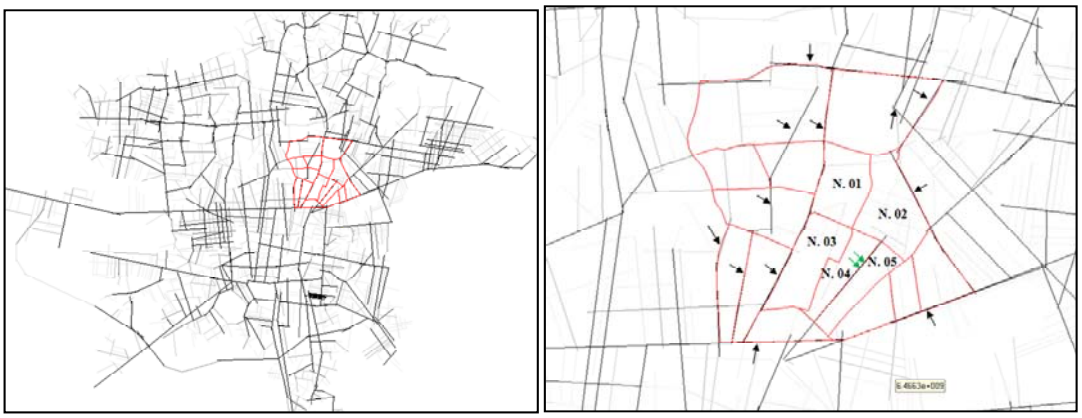

Figure 6-12: The streets with high value of choice crossing district 07

Figure 6-13: The location of district 07 in the city and the deteriorating areas in district 07

In order to clarify the situation, these five neighbourhoods are extracted from the case and the mean values of choice in different radii are calculated to have an in-depth comparison. This comparison is shown in Table 19. In this table, the dark cells represent the higher values of choice and the lighter cells represent the lower value of choice.

Table 19: The condition of the deteriorating areas in district 07[40]

	City	Normal Areas	Deteriorated Areas	District 07	The five cases
Integration/Rn Mean Value	1.355	1.324	1.386	1.459	1.426
Integration/R3 Mean Value	2.620	2.671	2.572	2.501	2.443
Choice/Rn Mean Value	12470	13247	11729	20403	7335
Choice/R10000 Mean Value	1789	1891	1692	2341	1303
Choice/R5000 Mean Value	275	260	289	329	271
Choice/R2000 Mean Value	19.75	16.27	23	21.6	23.5
Choice/R750 Mean Value	1.1	0.876	1.32	1.14	1.25

As shown in Table 19, the deteriorating areas of the case have the lowest mean value of integration R3, choice Rn and choice R10000, and in fact, it owes the values of integration Rn, choice R5000m, choice R2000m and choice R750m to its main street which has connectivity to the main street of the city. The results and discussions shown in this part support the assumption of the research regarding the effect of spatial isolation on the socio-economic exclusion of the deteriorating areas. It is highlighted that the deteriorating areas are not being visited by strangers as much as the non-deteriorating areas and if the regeneration plans want

[40] The choice measures are divided by 10.000.000 to make it easy to read in the table

to integrate the deteriorating areas both spatially and socially, the street network which could connect the area with the most visited streets, or the streets with a high value of choice at the scale of Rn and R10000, should be considered as the core of the regeneration plan. This approach could also direct more pedestrian movement through the neighbourhood and trigger the socio-economic interactions.

6.2. **What has emerged from the behaviour mapping and site observations?**

The focus of this research is to facilitate people's daily lives and enhance the accessibility of the deteriorating areas, in order to increase the number of the pedestrian visits from the deteriorating areas and encourage socio-economic interactions. In this regard, not only the spatial structure of the neighbourhood is important, but also the street life in the area will become crucial as well. In this regard, the importance of conducting site observations and its role in enriching the methodology is discussed in section 4.4.4. In this section, the street life in Tehran as observed are first described, and then interpreted.

6.2.1. **Interpretations of the descriptive analysis**

The results of factor analysis show that the activities mapped in the observations can be classified into five main components, which can explain more than 70% of all the observed activities. The pattern of activities and the relationship between different activities are also presented by Figure 5-28 to Figure 5-41, and are discussed in this part.

The results for the observations show that the frequency of use according to the time of day is the same in all the streets, [Figure 5-28], and the number of people in the street decreases from the morning to the afternoon, and increases again in the evening in all cases. This can be simply because of two reasons. In the morning, and after the rush hours, the employees are at work and people observed in the streets are housekeepers, young people or retired people who are enjoying their time outdoors. However, in the afternoon, these groups, especially women, do not need to be outdoors and the activities reduce to those such as the school children being picked up by their parents after the school time. Another part of it could also be due to the climate and the season in which the observations were conducted; during the summer and early fall. However, in the evening when the schools are finished, and many

of the employees are done with their jobs and the weather is cooler the total number of activities increase as expected.

The results of the relationship between global and local integration and the total number of observed people in one complete day for the four observed streets [Figure 5-29 and Figure 5-30] show that with the increase of both global and local integration, the number of observed people in the streets also increased. Among them, Sabalan Street behaves differently on a global scale, where with the increase of global integration, the number of observed people has not necessary increased. This is also a case for the number of women present in the streets. The trend of women present in the streets follows the trend of local integration in all streets – though there is an exception for global integration with Sabalan Street [Figure 5-31 and Figure 5-32]. The reason for Sabalan Street being highlighted as an exception here is the nature and the history of this street. This street originally was neither a major street nor an important street in the local scale, and, in fact, it is the street where motorcycle shops and services are located. However, recent changes in the urban fabric resulted in it becoming connected to a main street, increasing its integration.

The trend between local integration and different types of activities [Figure 5-33 - Figure 5-35] shows that while there is a positive relationship between the changes in local integration and the necessary and social activities, it is not the case for optional activities. It implies that the streets with higher local integration values can support more necessary and social activities, whereas having a higher local integration does not necessarily support optional activities. The reason for this could be the fact that higher local integration means more people visiting the street, and as a consequence, more necessary and social activities could happen. However, the literature (Gehl, 2006) suggests that optional activities are more dependent on the quality of the built environment, and the charts also suggest that there is no specific relation between integration and optional activities. Although gender study is not the focus of this research, women's activities were carefully mapped since the literature (Jacobs, 2000) suggests that a sociable street should be useable for the most vulnerable people, including children and women. Thus, in Iran, where women's activities are restricted by Islamic laws – imposed on society by the Islamic government – the activities of this group were the interest of the research. In this regard, activities which could reinforce and support women's activities in public spaces, e.g. small businesses such as kiosks and vendors, were mapped in the

observation as one of the most effective factors on women's activities in the streets. With regard to this, the results [Figure 5-36 and Figure 5-37] show that while the number of 'standing women' follows the trend of small businesses, the number of 'standing men' does not. It implies that the presence of small businesses can have positive effect on standing of women in the street whereas this is not the case for men; this result is also supported by Mohammadi (2009). This is also observable for the number of women who are walking in groups. Where the number of small businesses has increased, the number of women walking in groups has also increased [Figure 5-38].

In relation to the hazardous activities and their effect on other types of activities, the results [Figure 5-39 and Figure 5-40] show that in comparison to the social activities, optional activities are more sensitive to the hazardous activities. The reason for this is that regional businesses are also classified as 'hazardous activities' and people who work in these businesses can still get involved in social activities and increase the number of this type of activity while their presence might be unwelcomed for the optional activities in which the residents of the neighbourhood are more likely involved. The relationship between the presence of men and women in the streets [Figure 5-41] suggests that the presence of men and women in open spaces are considerably related together and have a positive effect. Mohammadi (2009) also highlighted that the presence of men reduces with gender separation and having mixed spaces, base on gender, can only affect the presence of single women in the space. This is an important finding in a context where the Islamic government put emphasis on gender separation in spaces, e.g. separation of single people from families, separation of girls from boys and etc., and in many cases control their interaction by the 'moral and fashion police' regardless of its success.

6.2.2. **Analysis of site observations**

Behaviour mapping helps the research in conducting more quantitative and technical discussion about the street life, but site observation and its interpretation could give a clear idea of what is currently happening in the streets of Tehran. In this regard, the observed streets are first described and their street life is introduced and discussed by presenting pictures and more subjective interpretations.

6.2.2.1. **The descriptions of the observed places**

The most integrated street of the deteriorating area – Namjoo Street, shown as street number 01 in Figure 4-15 – is identifiable with four drive lanes and two narrow, though not well – developed, sidewalks along it [Figure 6-14]. Despite the unpleasant streetscape and narrow space for street life, the street has accommodated so many local retailers and shops all along the street frontage, as well as variety of small activities; everybody in the street claims small pieces of the street and the sidewalk. The shopkeepers use the small area in front of their shops to identify their territory and vendors seek small, widened spaces to spread their goods. In many cases, the slope of the street turns some ledges into secondary seating, as Jan Gehl says, as shown in Figure 6-15, makes an opportunity for people, mostly men, to take a seat and keep an eye on the street; an activity which increases surveillance on the street and its security (Jacobs, 2000). All of these small activities, with the intention of claiming the public space back, make the sidewalk even narrower. However, the street life is lively due to the presence of the small activities and the flexibility of pedestrian movement. In fact, the presence of small activities such as the vendors in Namjoo Street is the only place for women to stop, hesitate, talk and greet other women of the neighbourhood, which usually happens not far away from these small activities [Figure 6-16].

Figure 6-14: The most integrated street of the deteriorating area, Namjoo Street

Figure 6-15: Ledges of the most integrated street of the deteriorating area

Figure 6-16: Vendors and kiosks work as magnets for the presence of women in the streets

Just next to Namjoo Street there is a small park, Namjoo Park, and a small square, Namjoo Square, which benefit from the location of the street as they attract people [Figure 4-18]. Namjoo Park is a very small park that is not even open to Namjoo Street because of a thin row of commercial plots, which acts as a buffer between the two, so the park has indirect access to the street through an alleyway next to it [**Error! Reference source not found.**]. Despite the small size of the park, it is fully used and occupied by different people, including the youth, women and children, and retired people. This is the only place one could observe the high presence of women and children. The interesting point is that it is a bipolar park, in which women and children are attracted to the playground, and the youth and men are attracted to the other side of the park, so they are separated by an invisible border [Figure 6-17].

Figure 6-17: Namjoo Park in the deteriorating area

Namjoo Square is located not very far away from Namjoo Park. In fact, it can be anticipated that, in the future, there is a possibility of development to join them together for the benefits of making a bigger open space. Like any other green spaces in Iran, this square is also fully designed with hardscape. Despite being surrounded by drive lanes it is a stationary place for men, and only men, to sit and watch the neighbourhood. Despite the park, which is a family place, this space is mainly occupied with men and, in many cases, immigrant workers. In fact, the street life for them is like a 'live cinema' and one could see men sitting in the square and watching this 'live movie' for the whole evening [Figure 6-18].

Figure 6-18: Namjoo Square in the deteriorating area

Street number 02, Madani Street, shown in Figure 4-15, is the most integrated street in the whole region, which is under development and has almost the same character of Namjoo Street, but a district scale rather than a neighbourhood scale. It has four drive lanes with five-metre sidewalks along the street. However, in many cases, the sidewalk becomes narrow since the development of a street in Tehran might takes years as a result of legal regulations [Figure 6-19].

Figure 6-19: Madani Street with its wide sidewalks

In this street, one could also see people's attempt to claim the public space as the shopkeepers, the kiosk owners and the vendors try to capture the sidewalk piece by piece. Although there are no sidewalk cafes in Tehran, the sidewalk of the city has a complete story of its own; it is not a 'side + walk' space, but a 'side + workshop' or a 'side + plaza'. It is a workshop for the florist who does not have enough space in his small shop; a territory for the vendors to locate their stall; and finally a safe parking place for motorcycles to be away from cars [Figure 6-19 and Figure 6-20]. There are so many varied activities happening on the

sidewalk, but they all have a sense of urgency, and movement and dynamism are the main attributes of them.

Figure 6-20: The sidewalk is a people's workshop

Street number 05 in Figure 4-15 is Janbazan Street, which is no longer a part of the deteriorating area. It is a street with very well-developed and wide sidewalks, and a verge with vegetation along the street. However, the variety of activities is much lower than Namjoo Street or Madani Street [Figure 6-21]. Here, benches are provided for people, but there are hardly any users, no one is interested in spending time on them, and there are no 'spectators' for 'live movies'.

Figure 6-21: Janbazan Street

In the middle of Janbazan Street there is a big square acting as an 'island-park' [Figure 4-19]. This 'island-park' is also fully designed with the principles of the Persian gardens with a pond in the main axis [Figure 6-22]. Despite being surrounded by three drive lanes around the square, this place is indeed the neighbourhood's centre, which is being used during all times by different users. In the morning it is mainly occupied by retired people, while in the evening it

is being used by families and youth. The main activity happening in this island-park is greeting. There is a 'weak tie' (Granovetter, 1983) between people who do not necessarily know each other, but look familiar in their daily face-to-face interactions, which keeps them together and triggers conversation [Figure 6-23]. If television gives people news around the world, this 'weak tie' and conversations give people news about their neighbourhoods (Jacobs, 2000).

Figure 6-22: Nabovat Square

Figure 6-23: Nabovat Square

One of the streets that has been observed is Keshavarz Boulevard. Observing this street offers a good opportunity to see how a green street with vegetation and urban furniture is being used by people [Figure 6-24]. This boulevard is mostly being used by people who are crossing the area, and just want to rest for a while. There are no groups of retired people, youths or women and no gossip or 'neighbourhood news'; as Jane Jacobs suggests. One of the main reasons for this is the location of the street, which is in the business district, as it is visited not as a destination of a journey but as a pathway, although even in the lunch time or after work; it is still not being used as heavily as anticipated for a green pedestrian route.

However, it is obvious that what is said here, as well as for the other observed streets, is just a narrative of the life happening in this space, and an in-depth behaviour mapping is needed to understand the relation between the streetscape and its components and users' behaviour.

Figure 6-24: Keshavarz Street

Figure 6-25: Keshavarz Street

One of the most interesting streets has been observed is 15th of Khordad Street, which has been recently transformed to a pedestrian route [Figure 4-20]. This street is just next to the Tehran Grand Bazaar, which does not have rich urban furniture, trees, vegetations or other accessories. The only main thing happening in this street is the absence of cars. As soon as the authorities closed the street for the benefit of pedestrians, people claimed it back and captured the whole street, as if there is a 365-day festival happening in it [Figure 6-26]. There are bicycle stations provided for people and it is the only street whereby cycling has been seriously taken into account as a mode of transportation [Figure 6-27].

Figure 6-26: 15th of Khordad Street

Figure 6-27: 15th of Khordad Street

People mainly walk in the street and pass time. They also occasionally sit and have a cup of tea from the vendors or the tea kiosk. Women freely sit, move and linger in the place for hours without feeling unsafe or uncomfortable [Figure 6-28]. The whole 'army' of people shopping and selling their goods to others is the main 'live movie' for attracting people, and encourages them to stay and spend their time in the space.

Figure 6-28: 15th of Khordad Street

6.2.3. **Main points in interpreting the observations and the Tehran street life**

The liveliness of the streets in a city depends on the variety of activities in the streets, and how the built environment supports and facilitates their occurrence (Moughtin, 2003). However, in addition to the streetscape and the built environment attributes, the cultural background of the society has a great influence in forming activities in public spaces (Lillebye, 2001). Looking to the Persian and Roman traditional urbanism can say a lot in this regard. In Roman-like cities, the activities in the open spaces could be seen, and still happen, in the plazas, squares, and parks which are more likely to be stationary places; a place to take a seat, grab a cup of coffee and spend some time in one place (Marcus, Francis & Russell, 1998, Moughtin, 2003). Even now looking at European cities such as Edinburgh or London, from the personal experience of the author, can highlight the level of supportiveness of public spaces for having stationary activities such as sidewalk cafés, street performances, snack and tea/coffee kiosks etc. which make excuses for people to stop and linger in the public open space. However, the public life in the traditional Persian cities can be seen in the bazaar, with its famous architecture, a 'public open space' that is actually semi-open due to its arcades. If we say 'form follows function' by its true meaning, then it is not far from reality that the predominant activity that occurs in the bazaar is movement due to its linear form (Browne, 1976).

This short narrative attempts to highlight that it is part of social culture in Iran that people, especially women or families, tend not to linger or expose themselves in public open spaces as a form of leisure, which in fact is changing, gradually, due to the public green parks, which are relatively new urban elements in Iranian urbanism (Ardalan, 1980). In this situation, where there is no side walk cafe or street performance to make people stop and linger in the place, social activities and optional activities are so fragile and close to the necessary activities, that their appearance or elimination from the streets strongly depends on how supportive, both spatially and physically, the built environment is. In fact, there is a greater chance of having social activities when there is an opportunity to have optional and necessary activities in the space (Gehl, 2006). A supportive space can make an opportunity for the emergence of so many social, optional and necessary activities, and a non-supportive space can reduce all the activities to the necessary activities.

The observation of the spaces introduced in section 4.4.4 revealed interesting aspects of street life in Tehran. The first outcome of the observation is that there are very subtle

differences between the three types of social, optional and necessary activities happening in the streets, which an unfamiliar eye cannot identify easily. However, very small spaces in the vicinity of the streets, such as squares and small parks, can make a big difference, especially for women and children's activities. Jane Jacobs believes that the city is alive when its streets are alive, and the streets are alive when they are friendly to the most vulnerable users, such as women and children (Jacobs, 2000). Therefore, the variety of street activities strongly depends on how supportive the street is for women and children. In fact, public open spaces should be places for different layers across society, especially the vulnerable social classes, including disabled people, women and children (Mansouri, 2008).

The site observation of the streets in Tehran, both in the deteriorating and non-deteriorating areas, suggests that there is a small amount of women and children's activities happening in the street as a social activity. One could see men lingering in the street, chatting to their friends, smoking cigarettes or talking on their mobile phones, but very rarely one could see the same for women. An important issue in observing the streets in Tehran is that no disabled people were observed in this research. The same for children, one could rarely see children playing in the streets near to the shops, the activity described as a part of the street scene in the literature (Gehl, 2006). It could be argued that missing a certain level of people, e.g. children or disabled people, in street activities is partly a result of having non-user-friendly streets.

Having a variety of activities in the space depends on several issues, which is also observable in Tehran's streets. With regards to this, an active frontage not only fulfils people's daily needs but also increases variety of activities in the space, which as a consequence causes social interaction (Marcus, Francis & Russell, 1998). A strong factor that could contribute to the street liveliness is the presence of vendors, which not only could attract people but could also increase the security of the space as well (Marcus, Francis & Russell, 1998). Kiosks and small businesses that provide people with food is another trick to attracting people into the public open space (Whyte, 1980). In the observed streets in Tehran, the importance of supporting small businesses also becomes highlighted. In fact, in all the observed streets there are only two factors that attract women to linger in the street, talk, and socialise together, even for a short time; they are either near the kiosks or the vendors [Figure 6-16]. The interesting element regarding these two small activities in the street is that one could usually see women

in a group of two or three just next to the kiosk or the vendors greeting and chatting for a while. This is the strength of the 'weak ties' (Granovetter, 1983). One of the interesting questions that rose from these observations, and needs more sociological research for further understanding, is why, where and when women stay in the streets to make a 'weak tie'? The initial outcome of street observations in this research suggests that women need a 'reason' to stay in the public space. This 'reason' is a social norm which is culturally acceptable for other people; and answers the question of 'why is this woman staying here?' Having vendors or kiosks in the street gives a clear reasoning to society for the presence of women, and this leads to the creation of groups of women next to them [Figure 6-16]. Also, the parks and green spaces that support children's activities are more supportive to the presence of women (Mohammadi, 2009), and more women could be seen in the social activities because the answer to the above question is clear: women are here because they are accompanying children playing in the playground. Comparison between Keshavarz Boulevard and Namjoo Park also support this idea that both spaces are people friendly. One is a park; the other is a pedestrian boulevard. However, there are much more women in the park. Many of them might not have children, but still, the presence of children in the playground gives a good reason for them spending their time in such a public space [Figure 6-17, Figure 6-25]. This might become more understandable by mentioning that prostitution is illegal in the Islamic republic, and the presence of women in public open spaces with no good 'reason' might be perceived as prostitution. However, all of these assumptions need to be studied in depth in a sociological research.

Another interesting point here is that due to the lack of interest from the private sector in creating a market in the deteriorating areas, there are more 'small and temporary businesses' such as kiosks and vendors in the deteriorating areas, and, as a consequence, a higher presence of women involved in social activities has been observed in the deteriorating areas. In fact, in comparison to the main street of the deteriorating area with Keshavarz Boulevard in the non-deteriorating area [Figure 6-24] which is a green street with a very nice pedestrian route in the middle, there are very few social and even leisure activities happening in the street. Apart from greenery, there is no other attraction in this boulevard to encourage people to spend time and get involved in leisure activities. What attracts people to public open spaces is that they are 'public', (Marcus, Francis & Russell, 1998), and when there is nothing to encourage people to interact in the space, there will be no spectators, and, in fact, empty

space discourages the presence of people in the space (Whyte, 1980). In the case of Tehran, it seems that the presence of small activities here and there in the street can support the social activities more effectively in comparison to the physical shape of the street (without rejecting its effect) and indeed people involved in the small businesses (the vendor, the kiosk owner, and the customers around them) are the focus of other people (Marcus, Francis & Russell, 1998, Gehl, 2006).

In Tehran, the main streets of the neighbourhoods have the potential to increase the variety of activities by supporting stationary activities. Increasing stationary places can start by providing primary and secondary seating, e.g. benches or ledges in the streets, or widening the streets (Gehl, Adams, 2004), which in the case of this research can be considered as an option by designating the leftover land plots after street network developments.

6.3. What has emerged from the route filtering system and transformability index?

As shown in Figure 4-1 the triangular methodology of the research consists of space syntax. observational methods and GIS and transformability index. In the previous two sections, the results of space syntax and observational methods are discussed. Space syntax is used to study the structural pattern of public open spaces and to see how it could be possible to direct people into the deteriorating areas and increase the number of pedestrian visits by developing a street network. Observational methods are applied to study the street life in Tehran and to study different activities that are currently happening in the streets and evaluate the level of people interaction and classify the street activities. However, the role of the transformability index is crucial in this research since it makes a balance between the holistic approach of applying space syntax and the fine approach of observational methods. It takes the socio-economic conditions of the area into account and monitors the route filtering system.

Figure 6-29 shows this index for the deteriorating areas. In this figure, the map is enlarged to make it easier to be read. The boundary of the deteriorating area is shown with a dashed line and the deteriorating areas are located at the right hand side of it in this figure. In this map the lighter blocks represent the high cost of intervention and vice versa. This map shows the congestion of the dark parcels on the right hand side of the map and in the deteriorating areas. It confirms the poor physical condition of the parcels and land plots in the deteriorating

areas, which make the cost of intervention lower than the non-deteriorating areas. Comparing the result of this map with the Tehran Master Plan [Figure 4-12], which shows the location of the deteriorating areas and congestion of the dark parcels in the deteriorating areas, verifies the accuracy of this index.

The route filtering system and the transformability index are two methods to making the regeneration plan cost-effective. However, based on the objectives of the regeneration plans and the available data, the definition of 'cost', and as a consequence the result of these two methods, would be different than is presented in this section. Based on the interest of the research or the regeneration plan, the definition of cost could be the economic cost, legal cost, social cost etc. Since the objective of this research is to investigate the notion of spatial and socio-economic isolation highlighted in the literature, the route filtering system has been developed based on the local integration and justified with the transformability index which is developed based on the available data presented at Table 10. It is important to understand that although the result of the methods would be different from one research to the other, depending on the interest of the research or the regeneration plan, the method of developing such indexes still stands. In this regard, in the next chapter the potential application of the developed methods is presented.

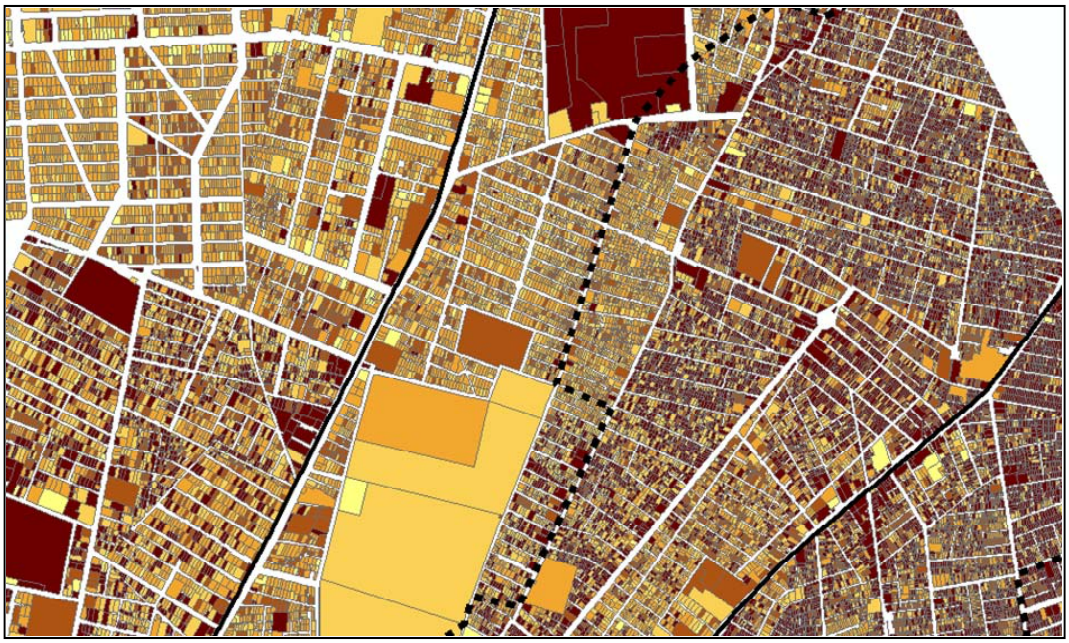

Figure 6-29: The two parts of district 07 in terms of transformability

6.4. **A General discussions**

After reviewing the literature of deteriorating areas and urban regeneration history in Tehran, the research hypothesised that the deteriorating areas in Tehran suffer from isolation from urban development process spatially, socially and economically. In this regard, the research formulated two main questions including how it is possible to increase the integration of the deteriorated areas into the surrounding urban fabric, and how it is possible to enhance the socio-economic condition of the deteriorated urban areas by increasing the pedestrian visits from the public open space of these areas. With respect to these questions, the research formulated an assumption that by investing in pedestrian-friendly street network development as a type of sociable public open space, it would be possible to release the deteriorating areas from isolation and attract more pedestrians and passengers into the deteriorating areas. As a consequence of the presence of people in the streets, these spaces could play the role of socio-economic stimulant zones and trigger the socio-economic regeneration as well.

In order to support this assumption, three sets of theories and methods have been applied in this research, the result of which are presented in chapter 5 and analysed and interpreted in this chapter. Here, a general discussion is presented to tie up all the results and analysis in supporting the assumption and deliver rigorous answers and evidences to the research questions. The discussions here follow the same order that the results are presented and analysed in.

In order to support the hypothesis of the research, regarding the deteriorating areas being isolated from urban development process, and to answer the first question of the research in terms of integrating the deteriorating areas into the bigger urban fabric, the theory of natural movement and space syntax have been applied. In regard to the spatial organisation and spatial structure of the city, the two interests of the TCRO in urban regeneration, the idea of centrality for the case of Tehran is studied. In this regard, the axial maps and the distribution of global integration show that, in fact, Tehran has also a strong city centre where the most integrated lines are accumulated, although it might not be as dense and as compact as other ‘mono centric’ cities such as London. With respect to Bertaud’s claim regarding Tehran as a ‘polycentric city’, the results of axial maps, both global and local integration, also acknowledge that Tehran has different ‘sub-centres’ where the most locally integrated streets are accumulated. The reason for this is the history of the city expansion and the way that different

villages in the north, south, east and west of the old town have developed and joined together, forming the present city of Tehran. Also Hillier's idea regarding 'pervasive centrality' is discussed for the case of Tehran to justify Bertaud's report and it is highlighted that Tehran also follows the pattern of 'multi-scale' centrality across the city. However, Bertaud's claim in regard to the absence of a strong CBD and the fact that Tehran city centre is not demographically as dense and as compact as it should be can be also acknowledged here. This is more related to the legislations and regulations of city land uses and construction, not necessarily to the spatial configuration of the city.

The result of applying a configurational study for the city of Tehran supports the hypothesis of the research in regard to the deteriorating areas being isolated spatially. The results showed that while the deteriorating areas are located at the edge of the most integrated streets of the city, their inner structure work as a barrier for these areas being integrated with the surrounding urban fabric, taking advantage of the potential of the most integrated streets. The result also confirms the deteriorating areas are visited more in local trips, and compared to the non-deteriorating areas, have less change in being visited by people from other parts of the city in global trips. This also supports the hypothesis of the research in regard to the deteriorating areas being isolated spatially, which encourages socio-economic isolation as well.

In regard to addressing the research questions, the statistical analysis revealed a positive and significant correlation between the distribution of the commercial land use and syntactic measures. It has been highlighted that the streets which have a high value of local integration, or a high value of choice at a local radius, have more potential in attracting the commercial land uses and trigger the socio-economic regeneration in the area. In regard to this, if a regeneration plan wants to increase the amount of pedestrian visits from the deteriorating areas with the aim of enhancing the socio-economic condition of these areas, the streets that are used or being visited at the local scale should be the focus of regeneration plans for further development. As a result, the route filtering system has been developed based on the value of local integration in order to highlight the potential streets for further development for the case study of this research. However, in order to take the socio-economic condition of the neighbourhoods into account in the route filtering system, and highlight the potential streets for

further development, a transformability index is also developed which shows the accumulation of the parcels in a poor condition in the deteriorating area.

Since the focus of the research is attracting more people and pedestrians to the deteriorating areas, people's lives and street activities are also taken into account by conducting observational methods. The results of observation showed that the street life in the deteriorating area could be explained by five major activities. It showed that local integration – the base measure for the routed filtering system – is positively related with both necessary and social activities. The observations also suggest that the presence of some activities can have a positive or negative effect on the other, which should be taken into consideration in regeneration plans. In this regard, the presence of small businesses such as vendors and kiosks has a positive effect on women's activities such as standing, gathering and forming a group. The observations also show that these small activities work as a magnet for groups of women and can increase the variety of women's activities in the space, and need to be taken into consideration in developing a 'pedestrian-friendly network'.

With regards to creating social stimulant zones, the observations highlighted the potential for and the importance of small widened spaces, e.g. parks and squares, near the locally integrated streets. It is highlighted that child-friendly spaces lead to women-friendly spaces, and the spaces which support children's activities are the only main spaces in which big groups of women are formed, and social interaction between different levels of the society can occur. This is highlighted more in the context of this research, where the observations and descriptive analysis showed that the presence of women and men has a positive effect on each other. This means that if regeneration plans want to create social stimulant zones, they have no choice other than make it friendly to the most vulnerable groups of the society such as children, since the presence of women in social activities in the small widened spaces depends on the presence of children in that space.

In this section it is shown how the methodology of the research supports the research assumption and addresses the research question. But how can these methods lead to planning a 'pedestrian-friendly street network'? What could be the result of applying these methods for a deteriorating area? Also, what could this space look like if well developed? In the next chapter, the potential applications of the method for the deteriorating area are shown.

7. Chapter Seven: Potential application of the method for the deteriorating area

In this section, the method by which all the produced layers can be overlapped as an initial approach for developing recommendations for the regeneration of the deteriorating case is discussed. It is important to understand that the level of intervention applied here is structural and not physical. With regards to this, the aim of this part is to come up with some recommendations in regard to the structure of the deteriorating area to make it more integrated with the surrounding urban fabric. However, by fulfilling one spatial structure there might be different physical and formal solutions that go into a finer planning scale and gets closer to the field of urban design, leading to the re-blocking of the area, which is not directly the topic of this research. Before bringing any more discussions in regard to applying all abovementioned layers for the deteriorating case, it is important to summarise what has been produced so far to tie up all aforementioned discussions.

7.1. Summary of the produced layers

In the first stage, syntactic maps with a very high resolution were produced and justified with the literature, and the spatial problems of the deteriorating areas, including the case study of the research, were highlighted. As a result of this study it has been revealed that the deteriorating case of the research suffers from inner-structure conditions. Afterwards, a statistical study was carried out through conducting a correlation between the distribution pattern of commercial land uses, and the syntactic measure for the case of Tehran, to understand the underlying logic and pattern behind the socio-economic life of the city. Throughout this process it has been highlighted that local integration R3 has the highest significant positive correlation with the pattern of commercial land uses and is suggested as a stronger determinant for this pattern. At the next stage, all of Tehran's neighbourhoods are studied based on the mean value of global and local integration as well as the choice measure at different radii. The results implied that the mean values of local integration and choice at radius Rn and R10000m in the deteriorating areas are lower than the non-deteriorating areas, which shows the problem of the inner-structure of the deteriorating areas, as well as their low chance in being visited by people from other districts of the city. The results of the factor analysis and behaviour mapping revealed the patterns of the Tehran street life, which have

been classified in five classes. The correlation between these five factors, and global and local integration, also highlighted a significant positive correlation between the local integration with both the necessary activities and the social activities. However, it is acknowledged that more detailed observation with more resources could lead to a finer result.

At the next stage, considering the positive correlation of local integration with Tehran's commercial land use, as well as the social and the necessary activities, this measure is considered as the bedrock for developing a route filtering system, the streets in the deteriorating case were classified based on their local integration in three classes of high, middle and low potential streets. Also a control layer with choice measures at different radii was developed to optimise the decision-making and develop the streets in such a way to increase both the local integration and the choice measure at the same time. Another control layer, the transformability index, was also developed to consider the socio-economic condition of the families living in the deteriorating cases and make a link between the decision-making on a bigger scale with the socio-economic condition of the residents. Figure 7-1 shows an overview of the different methods that have been applied in this research.

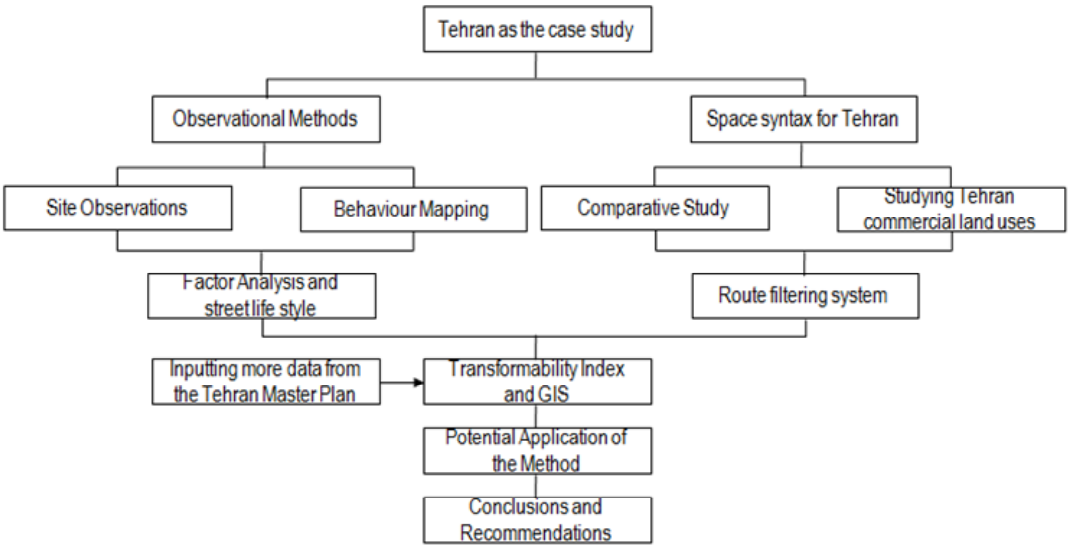

Figure 7-1: An overview to the methodology

At this stage we have three main layers available for further decision-making including the layer for the high, middle and low potential streets; the control layer; and the transformability index layer. Now the question here is how overlapping these layers can address the research question, which is discussed in the following sections.

7.2. **Identifying the objectives for increasing the integration of the case study**

The main aim of this research is to first develop more social streets to increase the integration of the deteriorating area into the surrounding urban fabric and get the most out of the lowest socio-economic cost. With regards to this, as Figure 7-2 shows, one of the mains streets of the city, Shariati Street, shown with an arrow in the left map, has a high value of choice, meaning that it is being visited frequently across the city, crossing from district 07 and dividing the whole area into two; the western and eastern parts.

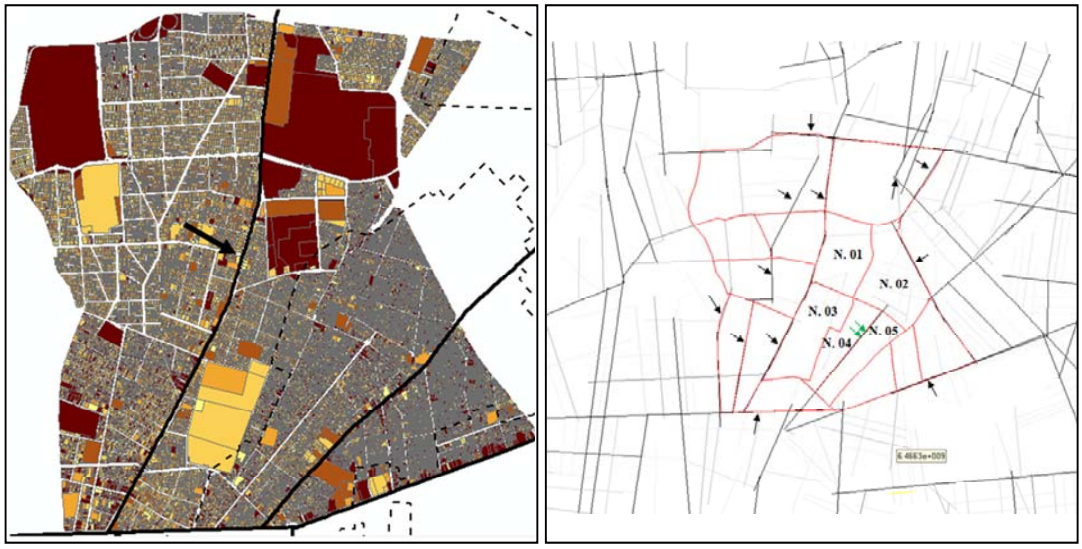

Figure 7-2: District 07 is divided in two parts by one of the main streets of the city

Farnahad (2005) has highlighted a considerable socio-economic and spatial gap between the two parts. As illustrated in the western part, there are several streets with a high value of choice being visited more often in the daily trips, whereas in the eastern side there is only one street highlighted with a high value of choice, confirming Farnahad's report. The gap is also associated with bigger land plots and a more regular street network, with longer and wider streets in the western part. The transformability index also confirms the congestion of land plots with poor conditions and a high level of transformability in the eastern part [Figure 6-29].

A comparison between the mean value of local integration in the western part and the eastern part also shows that despite the fact that the two parts of the district share so many streets, there is a 5% decrease in the mean value of integration R3 in the eastern part [Figure 7-3]. The same comparison was conducted comparing the length of the axial line. The mean value

of line length in the western part is 313 while the same value for the eastern part is 168, which shows almost a 46% decrease in the eastern part.

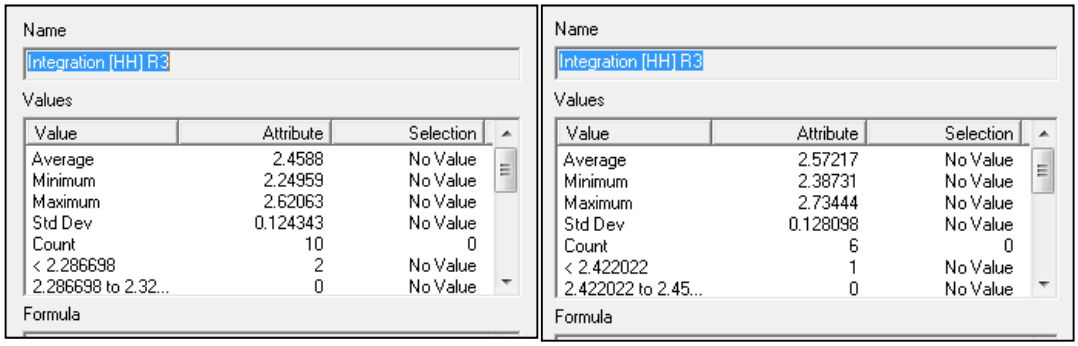

Figure 7-3: The mean value of integration R3 for the eastern part (left) and the western part (right)

These comparisons also confirm a gap between the two parts of Shariati Street. As a result, in order to fill the gap in district 07 and to integrate the deteriorating area, joining and integrating the two sides of Shariati Street should be the core of the regeneration plan; the decision which is also supported by Farnahad (2005). Another purpose for regenerating the area can be extracted from the discussion shown in section 6.1 in which the role of the main street of the deteriorating area is highlighted [Figure 6-5]. It is evident that this street has connectivity with the most integrated street of the city, and goes into to the heart of the deteriorating area. However, as a result of small urban blocking and the complexity of the inner structure of the area, it has not been integrated with the surrounding urban fabric and acts like a dead-end for accessibility and integration. With regards to this, the second aim of the recommendations focuses on releasing this street from isolation through expanding it outwards and towards one of the main streets in the surrounding urban fabric. This approach highlights the main street of the deteriorating area as a magnet by which the high and middle potential streets illustrated in Figure 5-43 and Figure 5-44 can be justified; meaning that the high and middle potential streets should make a connection with this street, and take the integration value into the surrounding neighbourhoods, increasing the overall integration of the entire area. Table 20 shows the strengths, weaknesses, opportunities and objectives in the regeneration of the deteriorating case and the policies in achieving the plan.

Table 20: The assessment of the deteriorating area

	Strengths	Weaknesses	Opportunities	Threats	Objectives
Socio-Economic Aspects	Retail as the main aspect of the urban economy Having several sub city centres Low cost of regeneration in comparison to the heritage sites Being surrounded by middle and upper middle class families	Limited women and children's activity in the street No public open space at the vicinity of the streets as the stationary places Care-orientated streets in the area	Car independency of the low families Walking and public transportation as the main mean of transportation Having variety of activities in the area Transformability of the area	High number of the families living in the area Having different immigrant quarters in the area Economic aspects of the developments	Increasing the number of the pedestrian visits from the area Increasing opportunities for social and optional activities Increasing opportunities for the creation of retailers in the area
Spatial and Structural Aspects	Being surrounded by the non-deteriorating areas Being located at the edge of the most integrated streets of the city Having the main street of the deteriorating area connected to the most integrated street of the city	Small urban blocks and complexity of the inner structure Being divided into two parts by one of the main street of the city Low level of integration and choice value in the eastern part	Having locally integrated streets in the area Having Shariati street in the area Having Enghelab Street at the border of the area Transformability of the area	Too many small urban blocks Urban fragmentation or gentrification Making trust for the residents and the private sectors	Increasing the accessibility to the deteriorating area as well as its integration Releasing the main street of the deteriorating area Connecting the two parts of Shariati Street in the deteriorating area

7.3. **Applying the developed methods for fulfilling the objectives**

In order to increase the integration of the deteriorating area, the potential streets shown in Figure 5-43 and Figure 5-44, which overlap with the streets with high value of choice Rn in Figure 5-45, are selected as the final destination for street developments [see Figure 7-4/01]. There is usually no more expansion for the selected street at this stage since they are more likely the main streets of the whole city. In the second stage, the potential streets, which overlap with the streets with high value of choice R10000m, are selected [see Figure 7-4/02]. These streets highlight the border around the deteriorating part of district 07. This map shows how interestingly the selected streets make a strong boundary around the deteriorating area, which offers both positive and negative opportunities for the neighbourhoods. The positive opportunity is that they can connect the inner structure of the deteriorating area to the surrounding urban fabric very easily, and the negative points are that they form a strong boundary, which facilitates movement around the area, which limits the permeability and discourages the necessity of having permeability into the neighbourhoods for the passengers. In order to take advantage of the positive opportunity and increase the permeability into the deteriorating area, any development for the selected streets at this stage (the blue lines) should be aiming inward towards the heart of the neighbourhood. At the third stage, the potential streets that overlap the streets with high values of choice R5000m are selected [see Figure 7-4/03]. It highlights the high potential streets within the deteriorating area that should be prioritised for further developments. The potential of these streets is that, if well-developed, they can connect the whole area with the main streets forming a boundary around the area (the blue lines) and facilitate the integration with the minimum cost. In this respect, some of the streets should be developed outwards, geared towards the border of the area and some other streets should be developed inwards facilitating the connectivity between the lines at the border, and the lines at the middle of the area. The selected streets at this stage (the orange lines) work as magnets in directing further inner structure development. With regards to this, the potential streets that overlap with high values of choice R2000m are selected [see Figure 7-4/04]. These streets highlight the routes in the deteriorating area connecting different neighbourhoods within the eastern part of district 07. The development of these streets should be outwards connecting the inner structure of each individual neighbourhood to the ‘magnets’ (the orange lines). In selecting the lines the transformability index has been always a strong indicator of the probable cost and feasibility of the development. However, in these maps,

because of the ease of understanding and reducing the variety of colours, the transformability index is shown as a transparent monochromatic layer.

Figure 7-4: Integrating the deteriorating area with the surrounding urban fabric

At the next stage, when the lines, their direction, and their purpose of development is highlighted, the recommendations can be implemented by space syntax analysis and the whole system is re-run from beginning to end to check the results [Figure 7-5]. Figure 7-6 shows the general strategy for integrating the deteriorating area into its surrounding urban fabric.

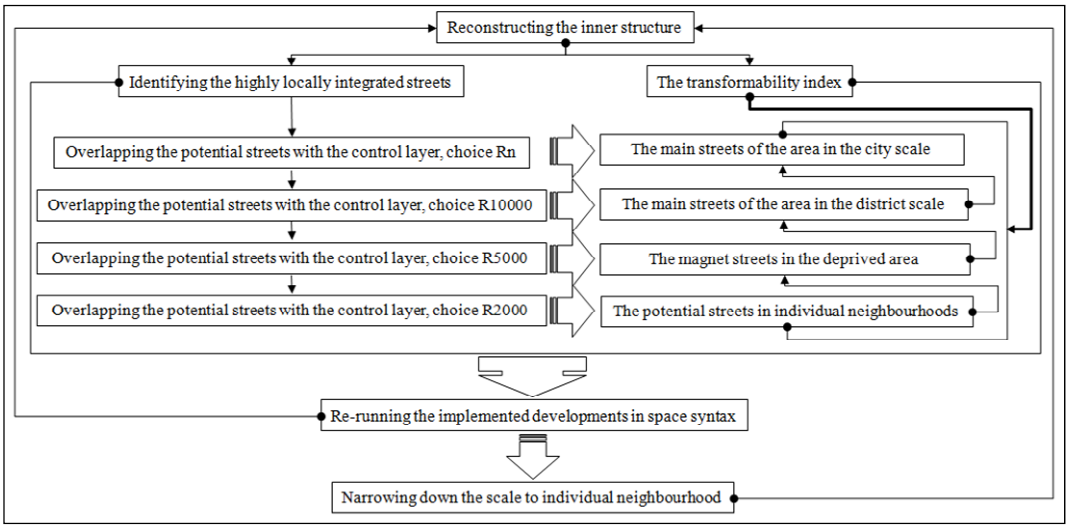

Figure 7-5: The step-by-step of modifying the recommendations

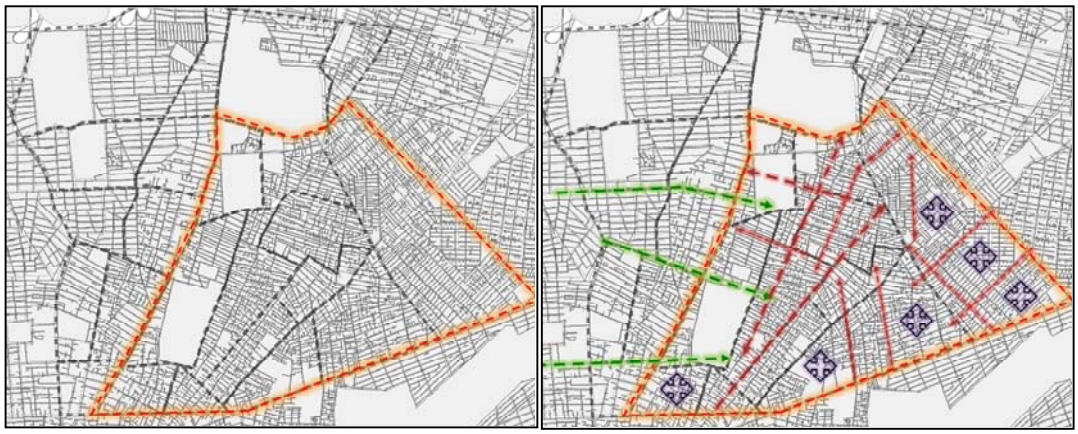

Figure 7-6: The strategy of integrating the deteriorating area into the urban fabric

It is important to realise that we are looking at a testable process, not a project, which can continue to the narrower scales and dig into each neighbourhood, identifying the potential of each individual neighbourhood one by one, and connecting them to the larger scale. However, at this stage, the recommendations for reconstructing the structure will remain at the district scale. Having the method highlighted as a process rather than a project allows the decision-making to be evaluated on an ongoing basis, optimising the decision rather than defining it as a project with a certain and solid outcome (Andalib, 2007a). With regards to this, it is vital to understand that the result of such a process is enhancing the structure of the area rather than manipulating the physical condition of the neighbourhood, since any physical intervention requires a more cross-disciplinary approach, which leads to the change in the neighbourhood's built environment. However, a structural approach talks about the configuration of the streets, the axial lines and their connectivity, and the syntactic graph behind the spatial configuration. In fact, as mentioned in the literature of space syntax, the axial lines of the area do not represent the streets, but the lines of movement, and the aim of this intervention is to make the movement lines more integrated and attract more pedestrian movement into the neighbourhoods (Hillier, 2007). The difference between the physical form and the structural form is that there can be several physical forms creating the same movement line, and, as a consequence, the same structure and spatial configuration. Figure 7-7 shows two different street layouts form the same axial line.

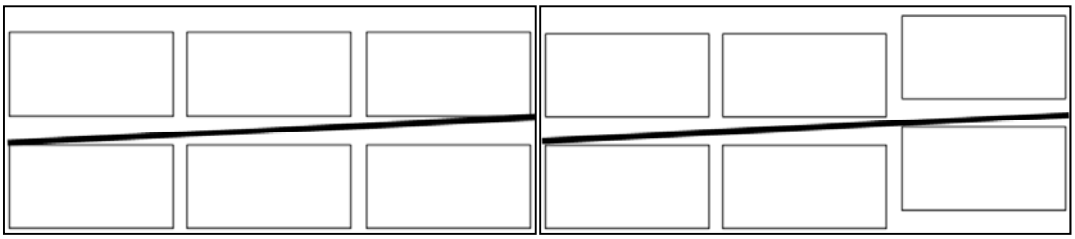

Figure 7-7: Two different street layouts forming the same axial (movement) line

Figure 7-8 shows the deteriorating areas before and after implication of the method increasing the integration of the area with the surrounding urban fabric. Figure 7-9 to Figure 7-12 show different parts of the same area in a bigger scale in order to make it easier to read. As can be seen in these figures, the structure of the neighbourhood did not transform dramatically at all, but it has been enhanced with subtle and careful developments of the movement lines. It shows that how by understanding the underlying pattern of spatial configuration of the streets; it would be possible to enhance the street network connectivity without causing urban fragmentation, which usually happens in Tehran's urban regeneration plans (Andalib, 2007a).

Figure 7-8: The deteriorating area before (left) and after (right) intervention

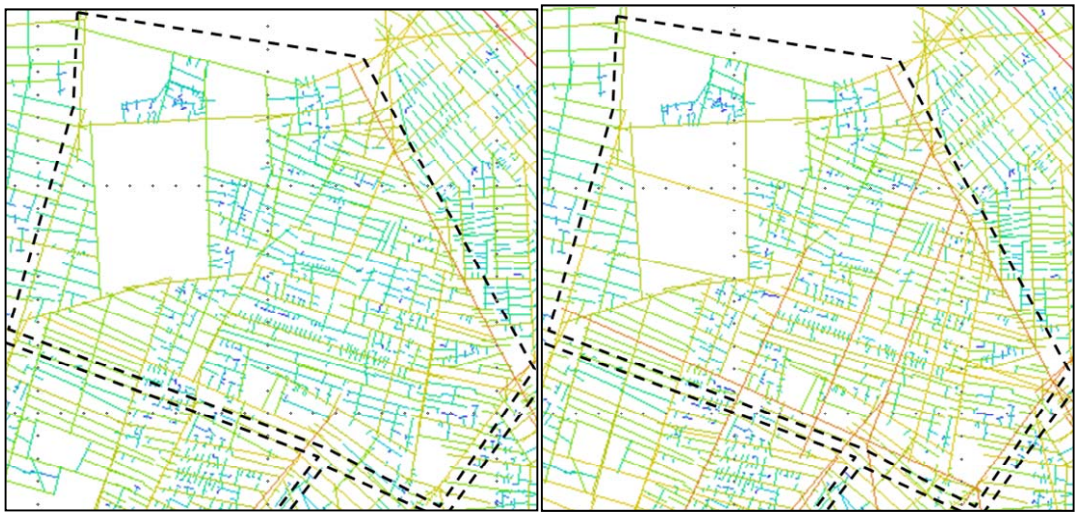

Figure 7-9: The deteriorating area before (left) and after (right) intervention, enlarged area

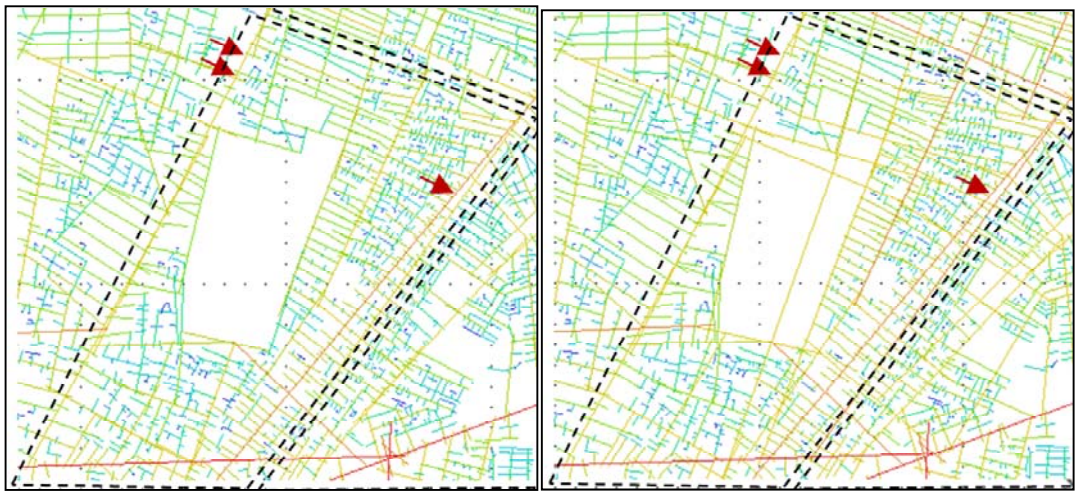

Figure 7-10: The deteriorating area before (left) and after (right) intervention, enlarged area

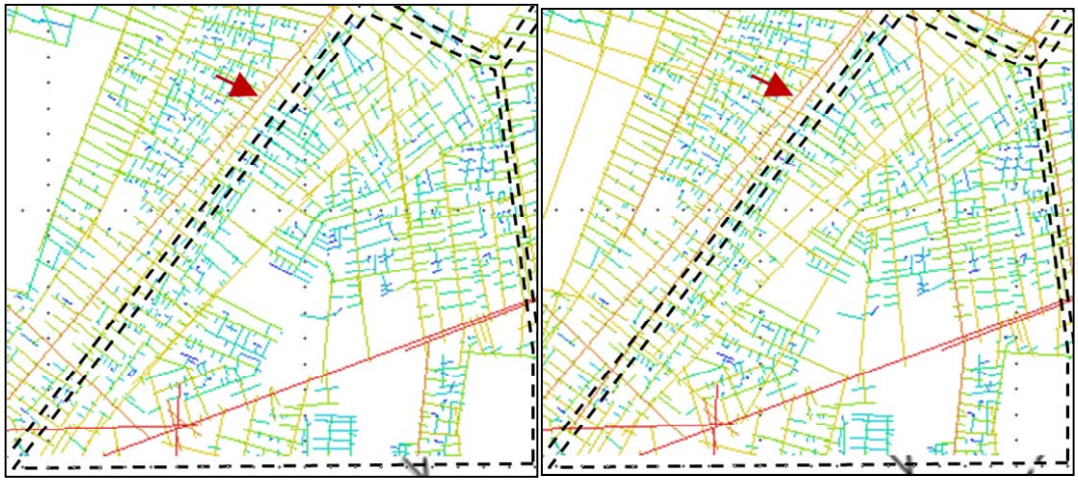

Figure 7-11: The deteriorating area before (left) and after (right) intervention, enlarged area

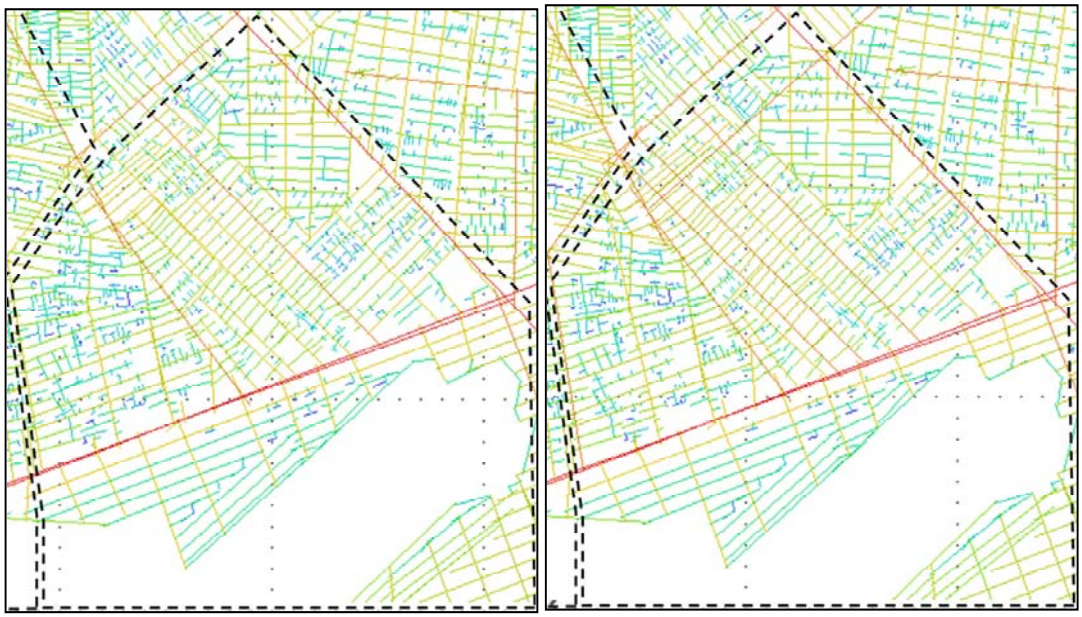

Figure 7-12: The deteriorating area before (left) and after (right) intervention, enlarged area

Figure 7-13 shows the streets with a high value of integration R3 in the area. As discussed in section 6.1.2 a comparative study between the spatial configuration of the streets in the deteriorating area and the control area revealed a fragmentation in the locally integrated streets of the neighbourhoods in the deteriorating area [Figure 6-5]. With regards to this, Figure 7-13 shows that how careful and subtle changes can fill the gap in the main framework and connect the locally integrated streets in the area to make the neighbourhoods more integrated. In this figure, the lines that became highlighted after implementing the recommendations area are shown with dashed lines. As can be seen, the objectives of the regeneration plan including releasing the main street of the deteriorating area and connecting it to the other main streets of the area, as well as connecting the eastern part of Shariati Street with the western part, are achieved by this approach.

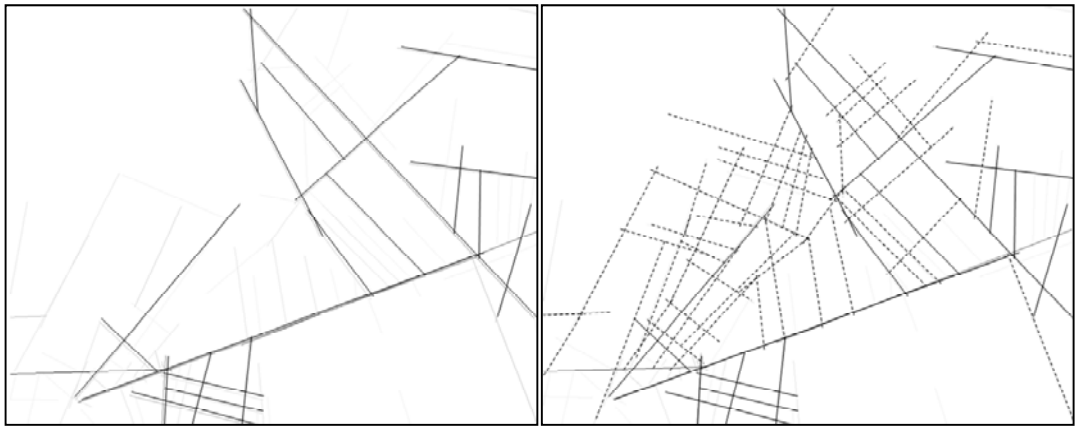

Figure 7-13: The framework of the main axial lines before (Left) and after (right) of intervention

As discussed in section 6.1.2 the most integrated street of the deteriorating area acts like a dead-end for accessibility, and the framework of the streets with a high value of choice – the streets which are being used more often – is also fragmented [Figure 6-8]. Figure 7-14 shows this framework before and after implementing the method.

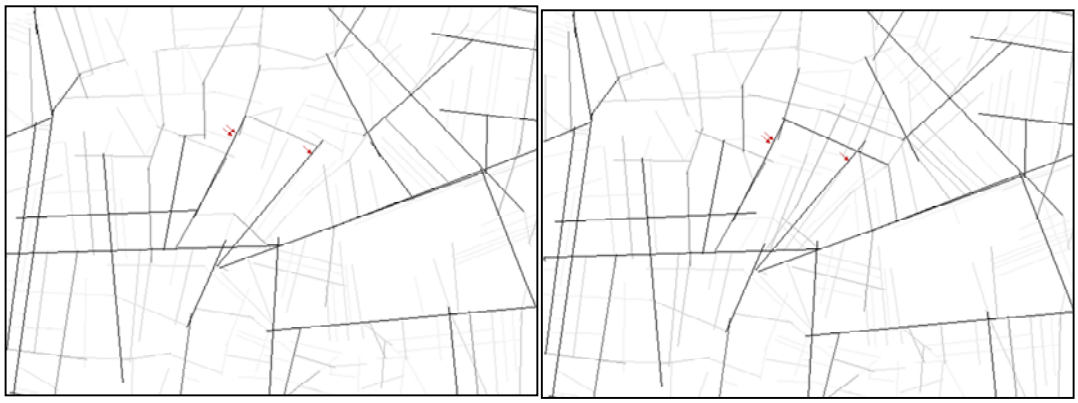

Figure 7-14: The framework of the widely used streets before (left) and after (right) of intervention

Figure 7-15 shows that how implementing the method and developing the axial lines can release the most integrated street of the deteriorating area, and make it contribute to the network of streets with a high value of choice. The lines which have had an increase in their value of choice, after applying the method were added to the network, are shown with dashed lines.

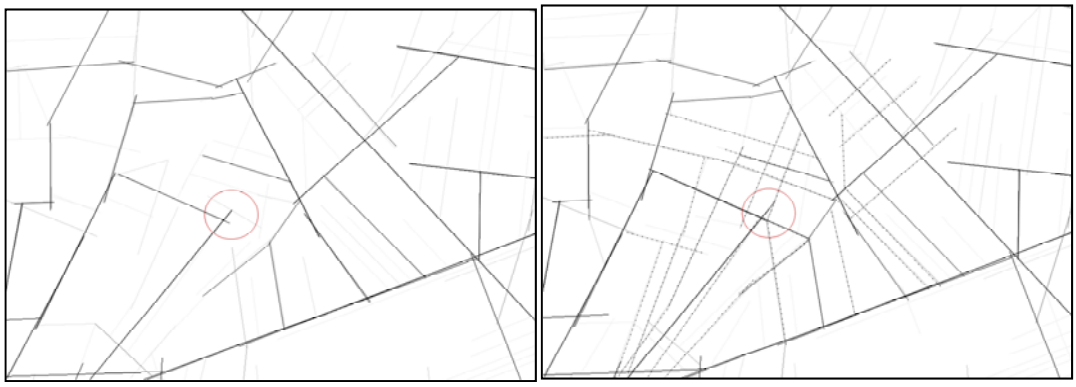

Figure 7-15: The framework of the widely used streets before (left) and after (right) of intervention

A numeric comparison between the deteriorating area before and after implementing the method shows that the value of local integration for the main street of the deteriorating area, before applying the method, was 4.89. This increased to 4.99 after applying the method, which shows an increase of almost 3%. Also the mean value of local integration for district 07 has increased from 2.45 to 2.57, which shows an increase of almost 5%, and the average length of the axial lines in district 07 has increased from 216, before applying the method, to 229, which is an almost 6% increase. The intelligibility of the whole sample area also increases from 0.549 to 0.568, which shows almost a 4% increase. The results show that applying the method for the case not only connected the eastern part of Shariati Street to the western part,

and enhanced the degree of connectivity in the network of the most accessible street of the area, releasing the most integrated streets, but also increased the value of local integration of the main street of the deteriorating area, as well as the mean value of the whole area. Also, it causes an increase both in the length of the axial lines and in the intelligibility of the area, and as a result reduces the complexity of the area, which is highlighted as a spatial attribute of the deteriorating area (Hillier, 2007).

Comparison between the plan proposed by the traffic engineers in the Farnahad Urban Planning Company and the outcome of implementing the research method for the case study confirms the effectiveness of the research approach. The current condition of the district is shown in Figure 7-16 (left map). Traffic-orientated decision-making supports the idea of continuing the main street in the deteriorating area forwards through the neighbourhood, demolishing the residential plots and connecting it to the main street [Figure 7-16, middle map]. However, the approach of this research can achieve the same result with respect to the current spatial configuration of the neighbourhood and reduce socio-economic costs [Figure 7-16, right map]. In order to understand the street network more easily, the city blocks are shown in white and the street network are shown in black in the maps.

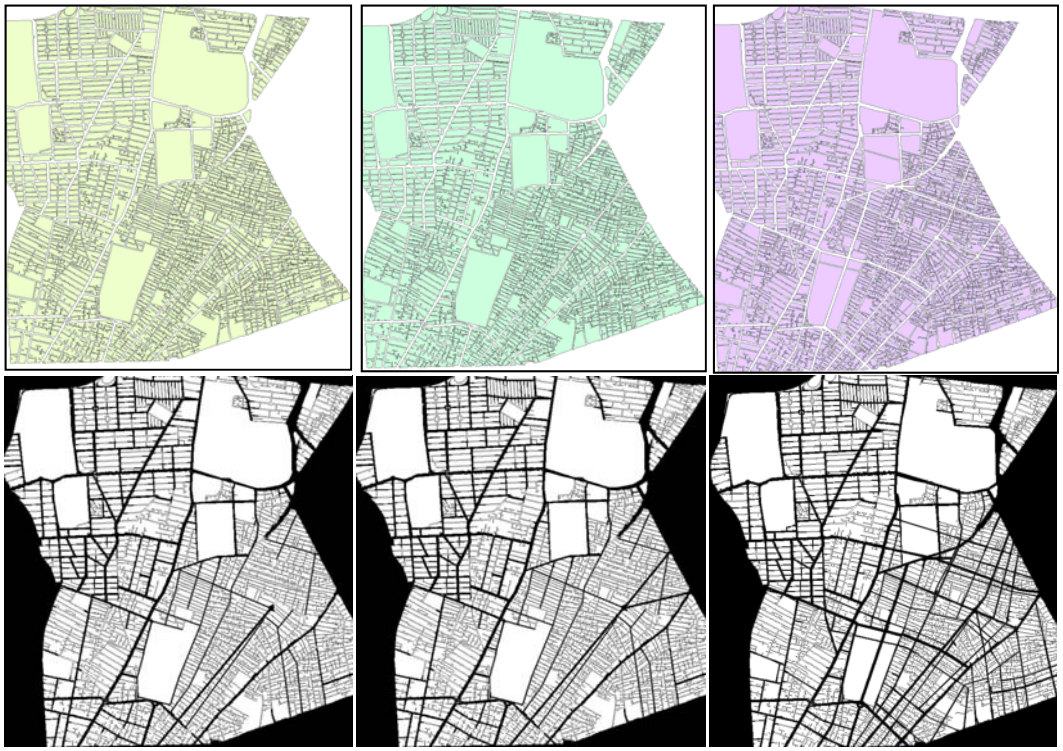

Figure 7-16: The comparison of street network development using the research method

As can be seen in Figure 7-16 the two main objectives of regeneration including connecting the western side of Shariati Street to the eastern part, and realising the most integrated street of the area, are achieved by applying the proposed route filtering system. It is important to consider that the objectives were assessed using a relatively wide scale, and the methodology could be reapplied using a more precise scale to achieve a more accurate set of recommendations. It is also important to acknowledge that each of the proposed street developments in Figure 7-16 are several options in increasing the integration of the deteriorating area into the surrounding urban fabric, addressing the main objectives, and this research is not trying to prescribe a certain set of recommendations for the case study. In fact, each of the developed streets in Figure 7-16 can be prioritised according to the objectives and the budget of the urban regeneration. One of the main tools in prioritising the streets is the transformability index, in order to optimise the cost. However, in each project, the authorities might consider a specific aspect of the project as the 'cost'. For instance, in the case of Tehran, the fact that the deteriorating areas consist of so many small land plots with one or a group of owners causes lots of legal problems for the authorities in dealing with regeneration projects (Andalib, 2007b). In this case, the legal problems might define the 'cost' rather than the financial aspects of the plans, and as a consequence the results of the transformability index and the set of recommendations would be different from what can be seen in Figure 7-16. However, the method still stands and is flexible.

In this previous chapter the potential application of the method in planning level is highlighted. The question here would be: Where does the route filtering system lead to and what does the atmosphere of this social network look like? In answering this question and in order to highlight the potential for further research the author has developed design ideas for the deteriorating case study which can be found in the Appendixes.

8. Chapter Eight: Conclusions & Recommendations

Throughout a review on the literature of Tehran's urban regeneration, this research highlighted a methodological gap in the TCRO's theoretical framework regarding spatial and socio-economic isolation of the deteriorating areas in Tehran. In order to contribute to the literature of the TCRO, this research focused on delivering a design and planning tool as the main objective. With regards to this, the research formulated the problem from the spatial point of view with respect to the socio-economic aspects of the deteriorating areas, and brought up three main questions, including: how it is possible to develop a design and planning tool to study the spatial structure of the deteriorating neighbourhoods in relation to the socio-economic condition of them in order to optimize the urban regeneration plans. How it is possible to increase the integration of the deteriorated areas into the surrounding urban fabric by applying the developed tool. How the developed tool helps enhancement of the socio-economic condition of the deteriorated urban areas by increasing pedestrian visits from the public open space of these areas.

Considering that the TCRO's theoretical framework emphasises on the socio-economic stimulant zones, which are public open spaces in nature, the research focused on public open space development in addressing the questions. In this regard, an assumption was formulated that 'by investing in spatial configuration and movement as the predominant activities in Tehran's public open spaces and recognising their patterns, it could be possible to make the neighbourhood free of spatial isolation and create movement to and through the deteriorating neighbourhoods, which could facilitate pedestrian flow and enhance public daily life. As a consequence, it could create more people interaction and enhance the social isolation as well as creating economic stimulant zones such as retailers and commercial land use'.

By the fact that 20% to 30% of residential neighbourhoods are usually occupied by a street network, the research narrowed the investigation down on the street network development emphasising on the differences between streets, arteries and thoroughfares. Since the focus of the research was pedestrian movement and the street network, the theory of natural movement formed the basis of the research and was supported with two observational methods including several site observations and behaviour mapping. With the aim of

investigating the research assumption and answering the main research questions, several sub-questions were formulated and studies.

In order to answer the first sub-question regarding the spatial condition of the deteriorating areas in relation to the whole city, and delivering rigorous evidences to the literature, space syntax was applied to the city of Tehran, and the spatial configuration of the entire Tehran street network was studied. Criticizing the notion of Tehran as a 'polycentric' city was the first outcome of this part. The application of space syntax for the case of Tehran verified that from a configurational point of view Tehran has a strong city centre where the most integrated lines are congested. It is also highlighted that the location of the deteriorating areas near this centre reduces opportunities for the city to have a strong CBD in a macro scale.

The results of axial maps highlighted the distribution pattern of both local and global integration, revealing interesting points about the spatial condition of the deteriorating areas. The global integration showed that the deteriorating areas are mostly at the edge of the most integrated streets of the city and in many cases the most integrated streets of the whole city crosses these neighbourhoods. It also showed that the affluent neighbourhoods are much more segregated in comparison to the deteriorating areas, and being spatially segregated is not the main issue in Tehran's deteriorated urban areas. However, the local integration revealed more local aspects of the deteriorating areas in Tehran, highlighting the inner-structure of the deteriorating areas as the main obstacle in permeability into these areas. Also the comparison between the spatial structure of the control district and the deteriorating case highlighted a fragmentation in the framework of the most accessible streets in the deteriorating case decreasing accessibility and discouraging movement in these areas.

The holistic approach of the research allowed having a comparative study between different neighbourhoods in Tehran, highlighting that the non-deteriorating areas in Tehran are working better locally and have a greater chance in being visited by people from different parts of the city for long distance journeys. It also facilitated to study the distribution pattern of commercial land use, showing that the local streets are more effective in attracting retailers. These two analyses revealed why the non-deteriorating areas have a better socio-economic condition; the results highlight the local conditions, from the configurational point of view, as the main reason.

In order to answer the sub-questions regarding the predominant type of public open space found in deteriorating urban areas; the type of activities are taking place in that public open space; and the pattern of use in the public open space, the research conducted two observational methods highlighting the socio-economical aspects of the streets in comparison to arteries and thoroughfares. Although the observations were limited to a manageable number of streets, the results revealed interesting aspects of the street life including that the social activities are more correlated with local integration. With respect to the second, third, and the forth sub-questions regarding the street life in public open spaces in Tehran, the observations revealed that 72% of all observed activities can be classified into five main groups including necessary, social, optional, hazardous, and occasional activities. The observations highlighted the importance of 'dynamic' activities, e.g. group walking, as the most predominant type of activity in public open spaces. It also highlighted the importance of small businesses such as kiosks and vendors for reinforcing women's activities in the streets encouraging the 'weak tie' among people.

In order to answer the research question in regard to increasing the integration of the deteriorated areas into the surrounding urban fabric and meeting the objective of the research, a route filtering system was developed as a 'design and planning tool'. In order to meet the question regarding enhancing the socio-economic condition of the deteriorated urban areas, and considering the results of applying space syntax for the case of Tehran, the route filtering system was developed based on the local integration, since this measure has the highest significant correlation with commercial land use, necessary activities and social activities. The results of this system showed how by understanding the underlying spatial pattern of an area, it would be possible to develop the street network without causing urban fragmentation. It also highlighted that it would be possible to identify the streets which are accessible enough and have the potential for the creation of retailers, and social and necessary activities, as the 'socio-economic stimulant zones'. The entire methodology highlights that a well-developed street network accessible to pedestrians not only can integrate the deteriorating areas into the surrounding urban fabric but could also increase the number of pedestrian visits from these areas and trigger socio-economic regenerations as well.

In order to enrich the design tool and take the socio-economic condition of the neighbourhood into account, a transformability index was also developed and joined to the route filtering

system. The results of combining the route filtering system with this index delivers the objective of the research in regard to the 'design and planning tool' and shows how the regeneration projects can be planned as cost effectively as possible. The methodology of the research has been applied to the deteriorating case as an example to show the potential benefits the methods can deliver in regeneration plans. The application of the methods in the deteriorating case highlighted the importance of understanding the underlying spatial pattern of the area in proposing recommendations and guidelines.

The results of this research highlight that without having a holistic approach to the deteriorating areas in Tehran and not considering their condition in the whole city structure, the regeneration plans might not be as effective as possible, and in some cases might contradict with each other from one neighbourhood to another neighbourhood. Underestimating the condition of the deteriorating areas in relation to the entire urban structure might also hinder in the deteriorating area to come up with recommendations, increasing the isolation of these areas rather than enhancing it. The outcomes also signify that the regeneration plans need one main idea as the coordinator in order to converge different decisions in the regeneration plans.

In order to clarify the potential application of the research, the developed methods were applied to the deteriorating case of this research, Tehran district seven. Moreover, in order to simplify the idea of 'integrated public open space' and the feasibility of its implementation in the case of Tehran, the idea of 'green bazaar' was proposed and illustrated with draft plans and sketches which are presented in the Appendix. It is shown that the current condition of the streets in Tehran, both from spatial point of view and functional point of view, have the potential to support this idea. It is also illustrated that how by identifying these potential it could be possible to exploit every single potential in order to optimize the cost in fulfilling this concept. Table 21 summarise the main findings of this research. Table 22 also shows some principles and guidelines need to be considered in the regeneration plans in Tehran.

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Table 21: The expected and unexpected findings

Expected findings from the literature	The findings of this research
The deteriorating areas are spatially isolated	The deteriorating area are at the edge of the most integrated streets of the city
The main streets are more supportive for the creation of the retail commercial land uses and necessary activities	The locally integrated streets are more supportive for the creation of the retail commercial land uses, necessary and social activities
The city polycentric city	The city has a strong city centre spatially
The deteriorating areas are not accessible	It is easy to reach to the deteriorating areas but it is not easy to have permeability into these areas
The non-deteriorating areas are not isolated	The wealthy neighbourhoods are the most segregated areas in the city
The street life in Tehran is poor	The street life in Tehran is describable by five main behaviour patterns
The presence of vendors has a negative effect on the street life	The presence of vendors who deliver local services has a positive effect on the street life
Namjoo Street in the deteriorating case should be developed straightforward towards the main surrounding streets	Namjoo Street in the deteriorating case should be connected to the main surrounding streets with secondary streets
Women's activities are restricted in public spaces	Women need an 'excuse/reason' to have social activities in public open spaces
Integration and commercial plots are highly correlated	The integration between Integration and commercial plots is significant and positive
Streetscape is an important factor in having street life in Tehran	Accessibility and local integration value is a stronger determinant for the Tehran street life

Table 22: Spatial and socio-economic guidelines

Spatial guidelines	Socio-economic guidelines
Considering the condition of the deteriorating areas individually in the whole urban structure	Identifying the pattern of use in public open space
Considering both local and global spatial structure of the areas in regeneration plans	Classifying the pattern of use in the space to facilitate further investigation
Having a step-by-step approach from a holistic scale to a more precise scale	Taking people's need from different layers of the society especially the most vulnerable ones e.g. elderly and children
Hierarchising the streets based on their configurational value in increasing the integration of the area	Taking the small activities which can create the 'weak ties' in the society into account
Starting the regeneration projects by investing on the high potential streets which can control the direction of more detail inner-structure development of the area	Increasing accessibility into the deteriorating areas for the residents and strangers
Taking the socio-economic condition of the area into account to optimise the cost of development plan	Providing small widened spaces near the streets for the creation of small businesses and for the stationary activities
Increasing accessibility and connectivity of the streets forming the main framework in the street network	Taking the tradition of urban planning which implies the socio-economic behaviour of the society into account
Identifying every physical and spatial potential in the regeneration process	Controlling vehicular movements and increasing the possibilities for pedestrian activities
Taking the current underlying spatial pattern in consideration for the regeneration plans	Optimising the regeneration budget base on the potential of the streets in supporting socio-economic activities

Table 21 shows that the research came up with findings that are in contrast with what the literature delivers. This includes that the literature says that the deteriorating urban areas are spatially isolated. This research found that this is true but it also highlighted that these areas are at the edge of the most integrated streets of the city. This research has also found that affluent neighbourhoods are the most isolated areas in Tehran and this highlights the difference between 'voluntary' and 'involuntary' isolation. Also the literature highlights Tehran as a 'polycentric' city but this research showed that from spatial points of view Tehran has a strong city centre.

There are few studies about the street life in Tehran and since plaza and urban squares are scarce in Tehran, it is expected that the public open space life is poor. However, this research showed that the activities happening merely in the streets of Tehran can be classified into nineteen categories. In this regard, the literature highlights that the presence of vendors has a negative effect on the street life. However, this research found that the presence of vendors who deliver local services has a positive effect on the street life. Also the literature highlights that, women's activities are restricted in public spaces but this research found that, women need an 'excuse/reason' to have social activities in public open spaces.

Based on the results of the research, some recommendations for urban regeneration are provide in Table 22. The guidelines are divided into the ones which enhance the spatial condition of the deteriorating urban areas and the ones which enhance the socio-economic condition of the areas. The guidelines relating to the spatial attributes of the urban fabric include considering the condition of the deteriorating areas individually in the whole urban structure; considering both local and global spatial structure of the areas in regeneration plans; hierarchising the streets based on their configurational value in increasing the integration of the area; and starting the regeneration projects by investing on the high potential streets which can control the direction of more detail inner-structure development of the area. The guidelines relating to the socio-economic condition of the neighbourhoods include identifying the pattern of use in public open space; and classifying the pattern of use in the space to facilitate further investigation; taking people's need from different layers of the society especially the most vulnerable ones e.g. elderly and children; and taking the small activities which can create the 'weak ties' in the society into account. These tables provide a platform for potential for further research which is as followed.

8.1. **Potential for further research**

This research tried to contribute to the literature of urban regeneration in Iran throughout delivering a practical methodology. However like any other research there are so many limitations, e.g. time limitations, financial limitations, material and resource limitations, which do not allow the research to cover everything. This research is an initial exploration into its context and makes a strong platform for further investigation, some of which are as follows.

In terms of the quantitative parts of the research, space syntax and GIS, the research has provided some materials such as axial maps and segment maps that can still be enhanced to a higher accuracy. Tehran is a very large and complex city and providing the axial maps for such a large city is not an easy task. In the case of large and complex cities, the literature suggests the usage of a road-centric line map extracted from GIS at the scale of 1:2000; however since such map was not available to the author, the maps are produced manually in AutoCAD. Although the author tried to do his best to produce maps as accurately as possible, the maps could be enhanced more accurately by using a road-centric line map or working in a group in which supervision by someone with a fresh-eye is available to control the maps.

The distribution pattern of commercial plots was investigated in the whole city at the scale of 1:10000. However the possibility of studying the same issue in the Tehran districts individually one by one to investigate the logic behind the urban economy is an interesting field of research. Also, in the case of deteriorating cases, spatial problems are just one of the main issues; however studies on immigrant quarters or crime are other interesting fields of research. The author would like to highlight a study on the distribution pattern of immigrant quarters or crime as important fields of research without which any regeneration plan might cause gentrification in the deteriorating areas.

Through reviewing the literature of space syntax, the author came across interesting fields of research for the case of Tehran, including urban centrality and city districts. The polycentric attribute of Tehran is used in this research by referring to the literature, but a lack of rigorous evidence, such as configurational maps, is a gap that could be addressed by using space syntax. Identifying urban territories and the city districts is also another interesting filed of research. This research used the Municipality districts, though the borders of these districts are usually defined with highways or the main arteries. A configurational approach to this

matter can capture a better idea of the concept of city districts especially with respect to deterioration.

This research conducted behaviour mapping and site observations to capture a general idea of the Tehran street life and came up with an initial classification in five categories. However, more research needs to be done in this regard to investigate the street life in Tehran and the potential of people's lives in public open spaces. Accessibility to public open spaces, which was the main concern of this research, is just one factor of having pedestrian-friendly streets and neighbourhoods, but more research can be conducted in order to investigate the effect of the streetscape and the components of the built environment in relation to people's behaviour and perception.

Transformability index and the route filtering system are other aspects of the research that can be enhanced through further investigation. GIS network analysis can enrich the route filtering system, and the cost definition from different points of view can enrich the transformability index.

Another potential for further research is to conduct a mixed-method research by linking space syntax and the theory of affordances. With regards to the affordances theory, most researchers considered the physical components of an environment and studied their relation to an individual's behaviour as the hot spot of their work. In fact, the properties of individual spaces are more or less the core of the literature of the affordances theory (Heft, 2010). This research would like to highlight that although the physical components, their layout, and the properties of individual spaces have strong influences on people's behaviour in that particular space, they are not the only function and attributes of the space. In this respect, this research would like to draw attention to the spatial attribute of the environment and make a link between the affordances theory and the natural movement theory. As Hillier highlighted, in his idea of 'spatial configuration, before any attribute of the space such as its shape, material, size, or anything else, it is its spatial configuration and its relation to other spaces which has the first impact on the user's perception (Hillier, 2007). In fact, the properties of individual spaces in shaping human space are not as important as the interrelations between the many spaces that make up the spatial layout of the built environment (Hillier, Vaughan, 2007). For instance, we cannot expect to enhance the social life of the deprived areas by merely modifying the physical elements of the streets and neighbourhoods, increasing 'affordances',

while they have inherited the spatial isolation. In this regard, this research assumes that the spatial configuration of the street would act as a 'relational attribute' of the space, as Heft says, and creates different affordances. This matter can be an interesting research topic for further research.

At the end it should be said that the researcher found that the Iranian literature is very well-developed in relation to the deteriorating areas and regeneration plans; however, having a narrative approach towards the problems and lack of evidence-based and practical approach is the main gap in the literature. In this regard, some research questions and assumptions are defined in this thesis and it has been tried to investigate the questions and support the assumptions through an evidence-based approach. Considering that some basic attributes of the city such as the spatial structure of the city are studied in this thesis, it can be said that, this research can make an effective platform and bedrock for further evidence-based and practical research about urban regeneration plans in Tehran.

Publications

Academic Journal Papers in Persian:

1. Rismanchain, Omid; Bell, Simon (2010); “The application of Space Syntax in studying the structure of the cities”. Journal of Fine Art, Tehran University, Iran
2. Rismanchian, Omid; Bell, Simon (2011); “Study the spatial segregation of the deteriorating areas in the spatial structure of the city of Tehran by using space syntax technique”. Journal of Bagh-E Nazar, Volume 17.
3. Rismanchian, Omid (2010); “Effective factors in the enhancement of pedestrian areas”. Journal of Bagh-E Nazar Volume 11.

Professional Journal Papers in Persian:

1. Rismanchian, Omid; Bell, Simon; (2011); “Study of the deteriorating areas in spatial structure of the city, a case study from Tehran”; Journal of Jostarhay-E Shahri, Farnahad Urban Planning Company. Volume 35
2. Rismanchian, Omid; Bell, Simon; (2010); “ A methodological approach in pedestrian movement management, a case study from Tehran”; Journal of Manzar, Volume 8

Conference Paper:

1. Rismanchian, Omid; (2008); “Landscape of Pedestrian”; 3rd National Congress on Urban Landscape and Green Spaces by Ministry of Country; Kish, Iran; (accepted for presentation)
2. Rismanchian, Omid; (2009); “The role of green space development in renewing a degenerating neighborhood, a case study from Tehran, Iran”; the 5th international conference of ‘CSAAR 2009: Sustainable Architecture and Urban Development’; Libya, (accepted for presentation)
3. Rismanchian, Omid; “Methods of Communication with People in a Participatory Urban Planning, a case of study from Iran/Bam CFC Project”; The 9th international conference of Towards Carfree Cities; York, UK. (accepted for presentation)
4. Rismanchian, Omid; Bell, Simon (2011); “Evidence-Based Street Network Development in deteriorated urban areas, A case study from Tehran/Iran”; International Conference of Urban Transport 2011 (accepted for presentation)
5. Rismanchian, Omid; Bell, Simon (2011); “A morphological approach in studying the spatial problems of the deteriorated urban areas, a case study of Teheran, Iran”. The Eighteenth International Seminar on Urban Form, ISFU 2011, Montreal (accepted for presentation)
6. Rismanchian, Omid; Bell, Simon (2011); “A morphological approach in public open space development in the deteriorated urban areas, a case study from Tehran/Iran”. ICON-LA international conference, Landscape architecture projects from theory to technical implementation, Russia (accepted for presentation)

Self-Organized Seminars:

1. Rismanchian, Omid; Bell, Simon (2011); Sharing the outcome of the PhD with the Iran Urban Planning Companies Association
2. Rismanchian, Omid; (2009); Space Syntax Workshop for the Tehran University PhD students at the Nazar Research Centre

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1. Rismanchian, Omid (2007), "A new approach to the forms of parks and greens spaces in Tehran". Landscape Architecture Electronic Journal. http://www.manzar.ws/
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Appendixes

The 'green bazaar': A draft design of the potential street life in Tehran

In the previous sections the potential application of the method in planning level is highlighted. The question here would be: Where does the route filtering system lead to and what does the atmosphere of this social network look like? In answering this question, the results of the observations could be useful, but prior to this, the concept that this research is originally derived from needs to be addressed. Pedestrian friendly street network is not something new in the Iranian urban planning tradition. In fact, Iranian cities are famous with their Persian bazaar as the socio-economic heart of the city. Browne, Kenneth (1976) described the bazaar as 'life line' including a set of streets which accommodate the religious, commercial, and social life of Iranian people; the type of space which is friendly to life in movement. Considering that this research also emphasized on the role of pedestrian-friendly and the sociable street networks in urban regeneration, ignoring the concept of the bazaar as an Iranian urban planning tradition would not be wise. This would be more highlighted by the facts that the route filtering system developed in this research is more suitable for the deteriorating areas with no heritage values whereas other alternatives need to be developed for the heritage sites like the bazaar neighbourhood. Also the bazaar neighbourhood is still working fine and lively after centuries and have the potential in enriching the concept of 'integrated public open space system'. In this regard, the route filtering system developed in this research can identify a set of streets which have the potential to form a social street network in each district in order to integrate the area into the surrounding urban fabric; however, the bazaar neighbourhood and the recently pedestrianized street, 15th of Khordad Street, can work as a magnet for all the sociable street networks across the city in order to fulfil the concept of the 'integrated public open space system'. In this section, this concept is illustrated in three main scales including the city scale, the district scale, and the street scale. It is worth noting that the aim of this section is just to introduce and illustrate the potential application of the developed methods in the planning system without going into more practical details. Appendix 1 shows the concept of the 'integrated public open space system' at the city scale and how different districts can be connected with the bazaar neighbourhood through the alternative routes identified in each district though the route filtering system. In Appendix 1 the deteriorating are, the case study of this research, and the bazaar neighbourhood are shown in white while the main streets of the

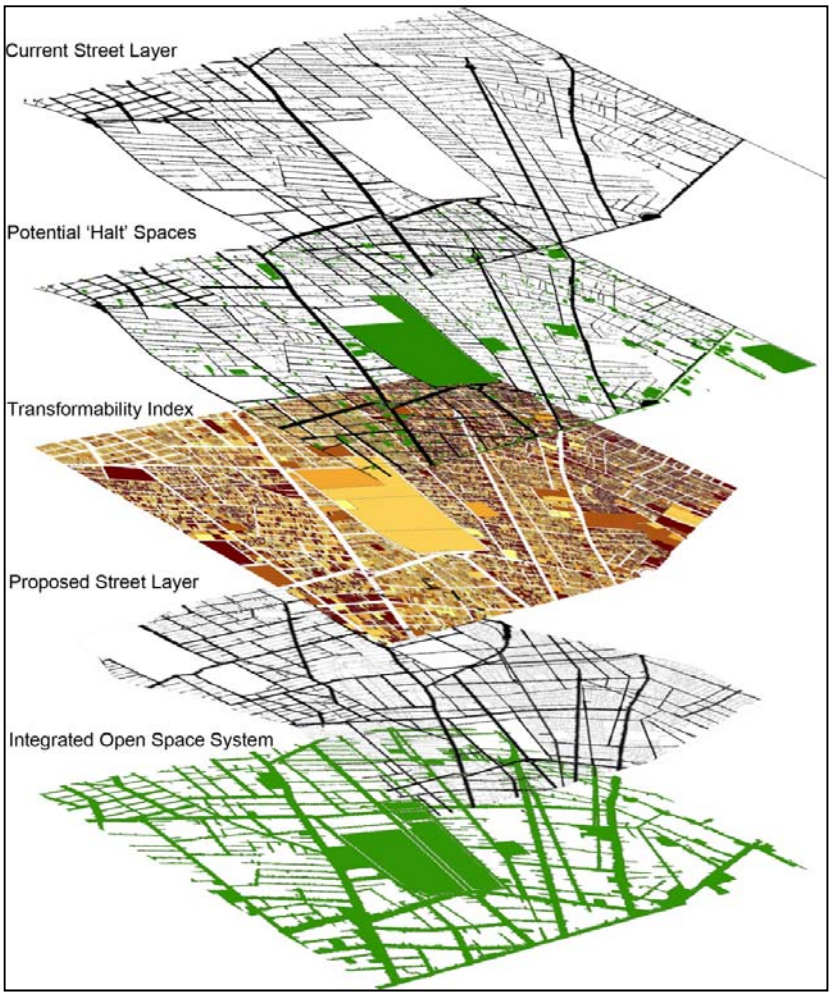
city are shown in yellow lines and the proposed sociable street network of the deteriorating area is shown with green and the alternative routes connecting this network to the bazaar neighbourhood are shown in black lines. The probable social street networks in other district also are shown with red arrows. This draft design highlights the potential of the Tehran streets and the current condition in providing a wide 'integrated public open space system' across the city if their spatial and structural potential be considered in the street network development.

Appendix 1: The concept of the 'integrated public open space system' across the city

Browne, Kenneth (1976) highlights hierarchical system of halt and movement spaces as the key element in the bazaar in accommodating variety of activities. This also can be seen the layout of the bazaar spaces shown in Appendix 1. The result of site observation and behaviour mapping of this study also confirms the necessity of the presence of stationary activities in Tehran street life which need to be considered in both the planning and the designing system. In this regard, Appendix 2 to Appendix 4 show the concept of 'integrated open space system'

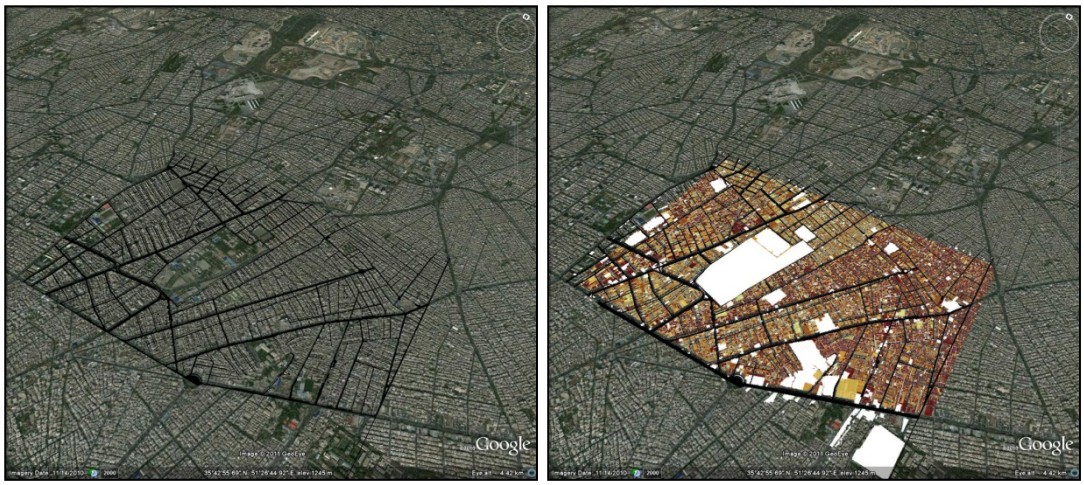
in the district scale for the case study of this research, district seven. This system also requires supporting both movement and stationary activities in people's daily lives by delivering a hierarchical system of halt and movement spaces. Appendix 2 shows different layers which forms the 'integrated open space system' including the current street layout, the potential 'halt spaces', the transformability index, and the proposed street layout. The potential halt spaces include existing parks and urban oasis, military bases and prisons sites[41], street plazas, forecourts and corporate and transit foyers and university campuses – which can be accessible to the public use while keeping their legal rights (Marcus et al., 1998). Making the necessary connectivity between these spaces and the street layout not only could increase the accessibility of these spaces but could also deliver 'halt spaces' to fulfil the people's needs in their daily lives. Additionally, the transformability index shows the land plots which could be transformed to public open spaces as the 'halt spaces' with the least cost.

[41] The military bases and prison sites originally were located on the outskirt of the city and joined to the city in the expansion of the city and according to the Tehran Master Plan should be moved to the outskirt of the city to the benefit of public open spaces.



Appendix 2: Different layer in forming the 'integrated open space system' in district 07, Tehran

The overlay of these layers is shown in Appendix 3 and Appendix 4. Appendix 3 (left) shows district seven with the current street layout and Appendix 3 (right) shows the potential halt spaces in white overlaid on the transformability index. Appendix 4 (left) shows the proposed street layout for the deteriorating area which has the potential to increase the integration of the deteriorating area with the surrounding neighbourhoods as the result of applying the route filtering system developed in this research. Appendix 4 (right) shows the result of merging the potential halt spaces with the proposed street layout in the deteriorating area as the 'integrated public open space' at the district scale. It shows that if the current condition of the city of Tehran has the potential in delivering a hierarchical system of halt and movement pedestrian-friendly spaces if all public spaces be considered in a wider integrated system.



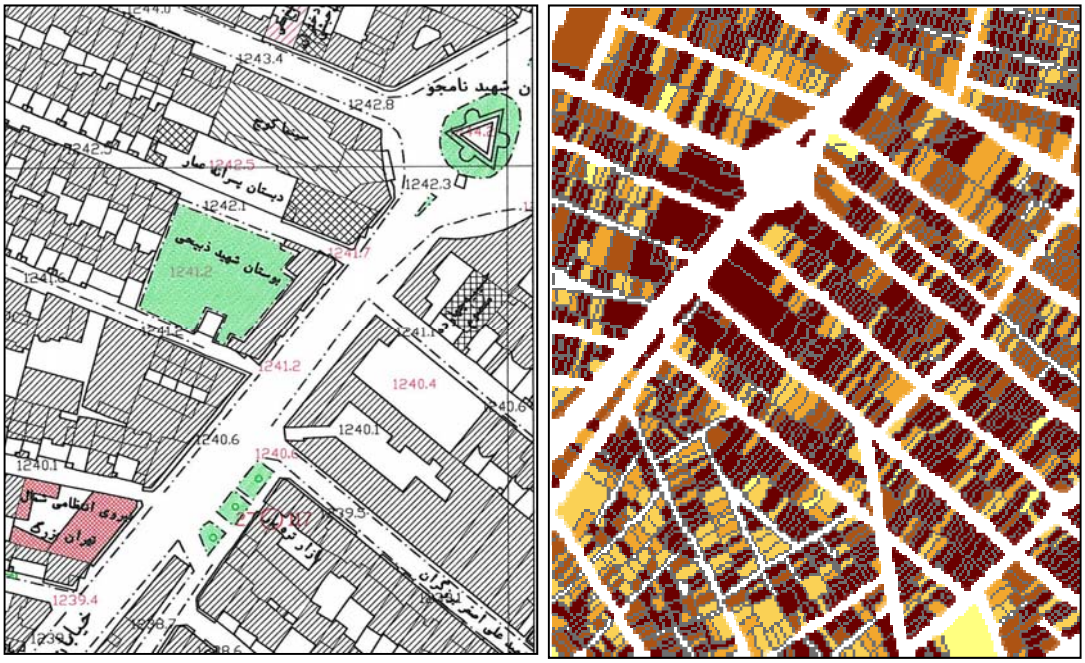
Appendix 3: The current street layout of the deteriorating area (left); the potential 'halt spaces' (right)

Appendix 4: The proposed street layout (left); the integrated open space system (right)

In the following the idea of having a sociable street network in Tehran is illustrated by focusing more on the current potential to be found at the neighbourhood scale in Tehran district seven. The following examples show how by changing the streetscape design at the neighbourhood scale, the potential of the current street layout can be exploited in order to support the idea of a sociable street and people's life style in it.

The first example is a draft proposal for developing Namjoo Square. As Figure 7-16 shows the most integrated street of the deteriorating case of this research crosses Namjoo Square and need to be developed towards the north. Also many other streets with potential for further development cross Namjoo Square and highlight the importance of this spot of the neighbourhood. Appendix 5 [left] shows there is a park near Namjoo Sqaure which is being blocked from the main street by a building. The transformability index shows all the building

blocks surrounding the park and the square in dark colour, verifying the low cost of transforming buildings to public open space [Appendix 5].



Appendix 5: Development of the 'neighbourhood centre'

Appendix 6 shows the current condition of the square highlighting the park, the square and the fruit market forecourt with green and the deteriorating building blocks with red polygons. An initial proposal for this spot of the neighbourhood is to unify the park, the square and the fruit market forecourt to make a unified public open space as the 'neighbourhood centre' where people can meet and socialize; the type of street life which is observed in Nabovat Square [Figure 6-22]. This task is achievable only by changing the land-use of the most transformable land plots and is a reachable 'socio-economic stimulant zone' in a short term.

Appendix 6: The condition of Namjoo Square (left) and the proposed 'neighbourhood centre' (right)

In order to express the probable streetscape of this spot, the fruit market forecourt is illustrated with more details as an example of exploiting the potential of the current condition of the area which highlights the importance of using every opportunity for creating the street plazas as the 'halt spaces'. As Appendix 7 shows there is a widened space in front of a fruit market next to Namjoo Street which is abandoned with poor vegetations, and low quality of design and maintenance. In order to increase the number of the 'halt spaces' and create spaces for stationary activities, e.g. women and vendors, any plan should exploit the potential of such spaces. Appendix 8 shows that how by modifying the connection of these spaces to the main street, Namjoo Street, and re-designing its landscape; the potential of the space for stationary activities can be exploited to accommodate people's daily life and support pedestrian activities.

Appendix 7: The current condition of the fruit market forecourt

Appendix 8: Exploiting the potential of current condition of the street in creating the 'halt spaces'

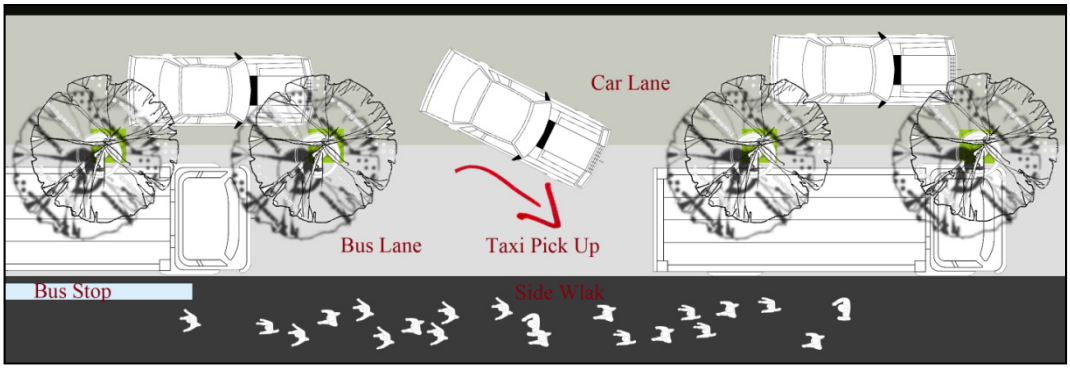
The approach of identifying the potential of the current condition of the streetscape can go into more details of design. An example of it can be highlighted in the most integrated street of the deteriorating area, Namjoo Street, which can be transformed to a pedestrian-friendly street with the lowest amount of cost as followed. This street is a 21-meter street with four 3.5-meter lanes for vehicular movement and transportation and two 3.5-meter lanes for vegetation, urban furniture and pedestrian movement [Appendix 9]. The main weaknesses of the streetscape are: narrow proportion of the sidewalk space which is surrounded by an 18-meter frontage; a 3.5-meter sidewalk, runoff channel and vegetation; and 6 to 8-meter height of the trees. This narrow proportion of the sidewalk not only does not allow the vegetations to grow up properly but also create too much enclosure for the sidewalk space and pedestrians. There is no connection between runoff channel and the vegetations. On-street parking works as an obstacle for vehicular movement. Having is no bus route. Not having a good connection between the small park near the street and the sidewalk. And not having enough space for urban furniture instalment.

Appendix 9: The current condition of Namjoo Street

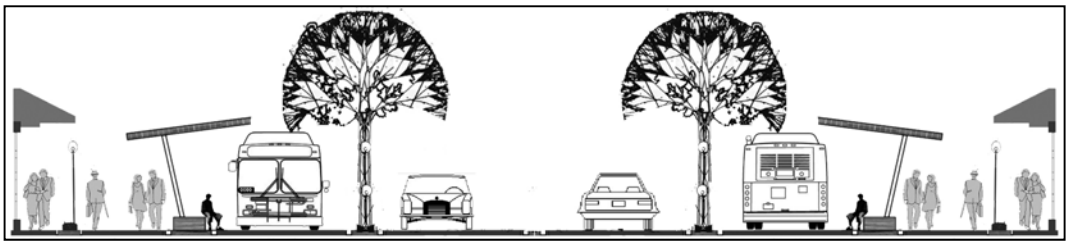
A simple proposal for enhancing the streetscape of this street in order to make it more pedestrian-friendly can be achieved by exploiting the potential of the current condition of the

street and its elements. The first thing to do is to move the sidewalk verge and runoff channel down the ground and cover the whole surface with mesh blocks which not only let the runoff water to the channel but could also let the vehicles to move over [Appendix 10, right]. The on-street parking spaces should be removed from the entire street for the benefit of providing a bus lane. Also the whole sidewalk verge needs to be moved between the bus lane and the car lane in order to widen the proportion of the sidewalk and correct the scale of the space. Planting the trees every five meter in order to give them enough space to grow up can also enhance the vegetation maintenance and the streetscape. Making a 10-meter gap between the trees should be considered to provide enough space for taxies to be able to use the bus lane to pick up passengers. Appendix 10 to Appendix 12 illustrate the general idea of what the atmosphere of this social street looks like with the case of Namjoo Street as a 'pedestrian-friendly' street.

Appendix 10: A draft sketch of the atmosphere of the proposed streetscape



Appendix 11: The plan of the proposed streetscape



Appendix 12: The section of the proposed streetscape

In this section the feasibility of having a sociable street in Tehran with relying on the current potential of the streetscape and exploiting these potential with the lowest amount of cost is illustrated. It is acknowledged that what has been proposed in this section is just a draft sketch of the idea of a sociable street and providing a comprehend streetscape design guidelines for the deteriorating areas needs a separate work considering the climate, population, legislation and regulations and etc. However it is important to illustrate where the route filtering system could be led to in this research.